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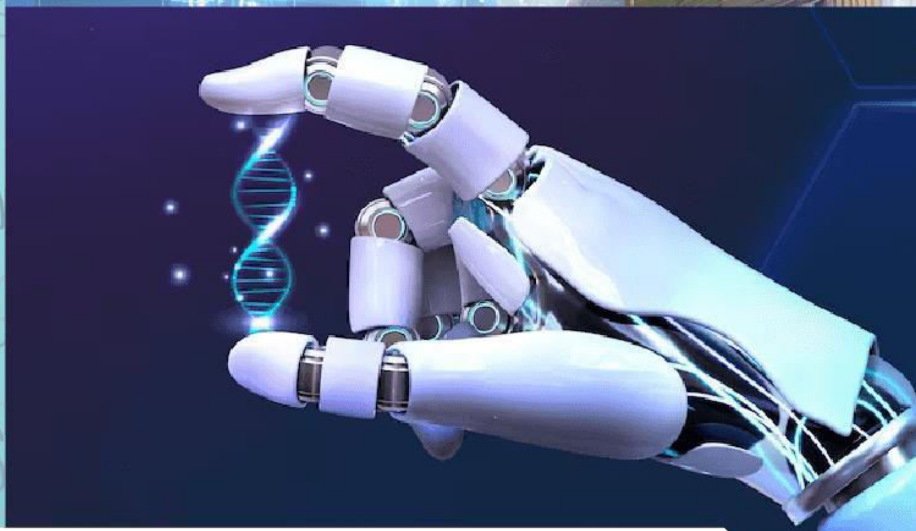

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Diabetic Retinopathy Detection Using Deep Learning

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ABSTRACT: Diabetic retinopathy (DR) is a common complication of diabetes and a leading cause of vision loss among working-age individuals. Early detection and timely treatment are crucial for preventing vision impairment. In recent years, deep learning techniques have shown promising results in various medical image analysis tasks, including the automated detection of diabetic retinopathy. We evaluate the proposed method on a large dataset of fundus images and compare its performance with state-of-the-art approaches. Experimental results demonstrate that our approach achieves superior performance in terms of both sensitivity and specificity, outperforming existing methods for diabetic retinopathy detection. Furthermore, we conduct extensive ablation studies to investigate the effectiveness of different components in our framework and demonstrate its robustness and generalization capability across diverse datasets. Overall, findings suggest that deep learning-based approaches hold great promise for the automated detection and classification of diabetic retinopathy. Such advancements could significantly improve the efficiency and accuracy of DR screening programs, ultimately leading to better management of this sight-threatening condition.

KEYWORDS: fundus images; convolutional neural network; deep learning; diabetic retinopathy; machine learning; retinal fundus image.

I.INTRODUCTION

Diabetic retinopathy (DR) is a progressive eye disease caused by long-term diabetes mellitus (DM), posing a significant threat to vision health globally. As the leading cause of blindness among adults aged 20 to 74, its prevalence continues to rise with the increasing incidence of diabetes worldwide. Timely detection and intervention are critical to prevent irreversible vision loss, yet the traditional methods of DR screening, relying heavily on manual examination by ophthalmologists, are resource-intensive and prone to subjectivity.

In recent years, the advent of deep learning techniques has revolutionized medical image analysis, offering automated and accurate solutions for various diagnostic tasks. Leveraging the power of convolutional neural networks (CNNs), researchers have explored the potential of deep learning in detecting and classifying DR from retinal images, paving the way for more efficient and scalable screening programs.

This work is motivated by the need to segment retinal images, and it describes automated methods and procedures to achieve this. These tools can be used for a wider range of problems that involve different types of images and parts to be identified. The process of manually dividing the blood vessels in the retina is difficult and takes a long time. As a result, automated segmentation is beneficial since it reduces the time and effort needed. The majority of algorithms used for segmenting retinal blood vessels focus on automatic detection, particularly for diabetic retinopathy, which is currently the leading cause of blindness

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In this, we outline the significance of diabetic retinopathy as a public health concern, highlight the limitations of current screening methods, and emphasize the potential of deep learning-based approaches to address these challenges. We then provide an overview of our proposed framework and outline the structure of the paper. Through empirical evaluation and comparison with existing methods, we demonstrate the efficacy and robustness of our approach in automating the detection of diabetic retinopathy, thereby contributing to improved patient outcomes and healthcare efficiency.

II.LITERATURE REVIEW

Pranay Liya, proposed Diabetic Retinopathy is a complication of diabetes that is caused due to the changes in the blood vessels of the retina and is one of the leading causes of blindness in the developed world. In our approach, we trained a Deep Convolutional Neural Network model on a large dataset consisting of around 35,000 images to automatically diagnose and thereby classify high resolution fundus images of the retina into five stages based on their severity. Volume: 06 Issue: 04 | Apr 2019 www.irjet.net

Karan v Dayal, proposed Diabetic retinopathy (DR) is a significant microvascular complexity coming about because of diabetes and keeps on seriously affecting worldwide wellbeing frameworks. The rising circumstance in the creating scene proposes diabetic retinopathy may before long be a significant issue in the clinical world for detection of DR. Diabetic retinopathy or DR is an ailment because of diabetes mellitus that can harm the patient image retina and also cause blood spills. This general condition can alsomake various indications from gentle vision issues total visual impairment in the event that it isn't convenient treated. Volume: 07 Issue: 03 | Mar 2020

In, modelled an Autoregressive-Henry Gas Sailfish Optimization (Ar-HGSO)-related DL method for identifying DR and severity level classifiers of DR and Macular Edema (ME) related to color fundus images. The segmenting procedure becomes highly essential for correct identification and classifying procedure that segregates the image into several subgroups. The DL technique can be used for effectual detection of DR and severity classification of ME and DR

Abràmoff et al., considered two fundus images from each eye which was analyzed by a retinal expert. Author applied two algorithms separately on the dataset. The result of applying the Eye Check algorithm gave an AUC of 0.839 and applying the Challenge 2009 algorithm gave an AUC of 0.821.

Gargey et al., developed a device for automatic discovery of Diabetic Retinopathy and classified the images into healthy or having DR. Author tested model using the public MESSIDOR 2and E-Ophtha databases for external evaluation and resulted 0.94 and 0.95 AUC values.

Wilfred Franklin and Edward Rajan proposed automated tool with high accuracy of the detection of blood vessels. Author worked on automatic segmentation algorithm on images of the DRIVE database and noticed 95.03% accuracy.

Liskowski et al. used super-vised approach along with deep neural networks on image datasets also proposed a supervised method which makes use of deep neural networks on raw images data. But they can work more efficiently on pre processed images. Author performs structured prediction with classification and produced result with AUC greater than 0.99,accuracy greater than 0.97. Results also derived sensitivity greater than 0.87 in fine vessels.

Revathy et al., used an SVM-based training approach to data and classified them into three classes as mild, moderate non-proliferative Diabetic Retinopathy and proliferative Diabetic Retinopathy. Approach used various classification algorithm and noted good accuracy with 82%

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III.METHODOLOGY OF PROPOSED SURVEY

Dataset

The dataset which we are using was provided with a large amount of high resolution retina images taken under a variety of imaging condition. The images which are provide in dataset are recorded from fundus camera which provides color fundus image of DR. A fundus camera is a small microscope that has a camera attached to it. It is used to capture images of the inside of the eye.

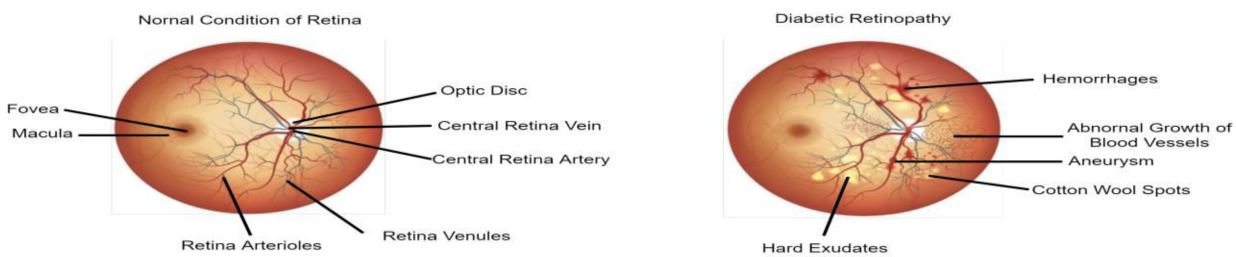

Figure 1. Illustration of the entire retina image

The fundus image was used to document the DR condition that is images gave the clear picture for detection. The clinicians are divided these DR into five classes which shows the stages of DR :

- No DR (class 0) - The person is not suffering from Diabetic Retinopathy
- Mild DR (class 1) - Within the Retina's minute blood vessels, small areas of balloon like inflammations.
- Moderate DR (class 2) - The blood vessels that sustain the retina are blocked at this stage. Within the retina, there might also be haemorrhages.
- Sever DR (class 3) - More blood vessels are blocked in this particular stage, denying several areas of retina of blood supply. The retina experiences a significant rise in the number of bleeding spots.
- PDR (Proliferative DR) (class 4) - New and abnormal blood vessels developed on the surface of retina. The newly formed blood vessels are fragile and can bleed, leading to potentially dangerous bleeding in the eye. They can also turn into connective tissue which will contract over time, causing the retina to detach and cause blindness.

Algorithm : Convolutional Neural Network(CNN)

CNN takes the images from the training dataset consisting of 5 different classes namely normal, mild, moderate, proliferate and sever. A fully connected neural network with three layers, namely input, hidden, and output, is the basic structure of CNN. Every neuron in CNN is connected to every other neuron. A convolutional neural network processes the input image and extracts relevant features. The pooling layer reduces the size of the feature map. The classification is done by a layer that has many connections and receives the flattened feature maps as input. Typically, each layer of the CNN learns more

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complex filters as it progresses. The initial layer extracts the fundamental features. The middle layer is responsible for recognizing the objects, while the final layer is in charge of identifying the object.

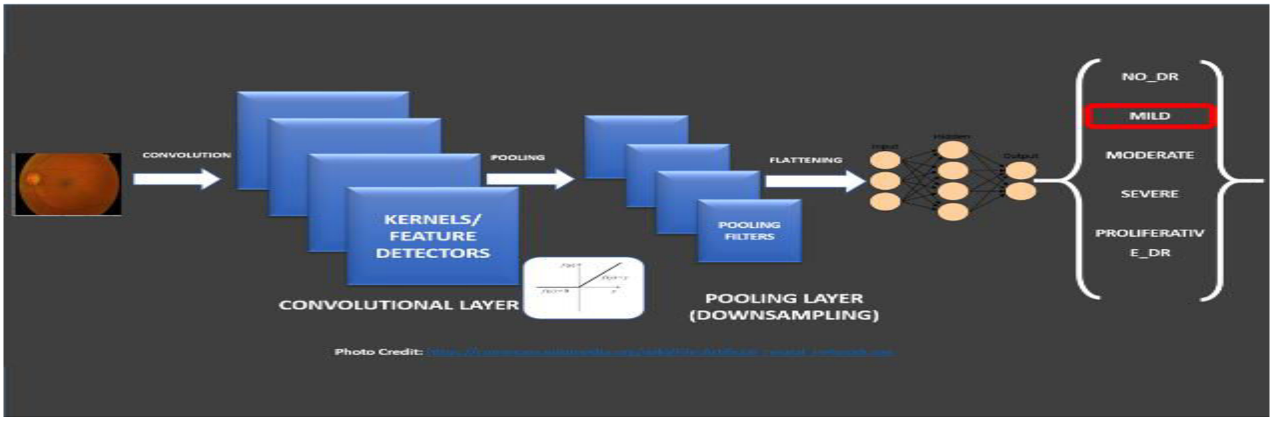

Figure 2. CNN Architecture

1. Convolutional Layer

The initial layer is a convolutional layer, which is responsible for performing complex computations that simplify subsequent tasks. This layer serves as the initial input for the image, receiving Fundus Image as its dimension. All the locations in the space will be covered by 3x3 filters as they move. The convolutional layer is made up of individual filters that operate independently. The image is processed through 32 separate filters, each producing its own set of feature maps.

2. Max-pooling Layer

In the Max-pooling layer, the most significant feature is obtained by reducing a 3x3 matrix into a smaller, more condensed form. The above 3x3 matrix is the converted into 2x2 matrix which involves only the highest weighted feature that is present in 3x3 matrix.

3. Flatten Layer

The layer flattens the image matrix into a one-dimensional array that serves as the input for the dense layer.

4. Dropout Layer

The dropout layer performs inexpensive and powerful operation that highly improve generalization abilities of the neural network. This technique randomly deletes and reinstates neurons in the training process, with the likelihood of deletion being controlled by a hyperparameter known as dropout rate

5. Dense Layer

All neurons in the previous layer are connected to the neurons in the fully connected layer.These layers are used as last elements of deep neural classifier, which are feed by the features extracted by the successive convolutional layers.

6. Output layer

Depending on whether the task is to classify something as one of two options or more than two options, the final layer of the network can be either a layer that uses a softmax function or a layer that uses a sigmoid function to give the output.

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IV. RESULTS AND DISCUSSION

This study explains the experiments that were conducted using the proposed model. The model classifies Diabetic Retinopathy into DR positive and DR negative. DR positive indicates that fundus image has Diabetic Retinopathy and the patient needs proper treatment. If the fundus image shows no signs of Diabetic Retinopathy, the patient does not require any treatment. The models were trained and tested on the dataset, with 70% of the data used for training and 30% used for testing We have shown how we gathered our data, explained what our data is, displayed our data and methods we applied. Now we discussing about the results we obtained from our experiments upon the implementation of this system. Our dataset has been split into two sections- one for training and the other for testing. In this chapter, we will demonstrate the results of the training and testing datasets. As mentioned before we have used deep learning algorithms. First, we trained our dataset with these CNN algorithms and then we built a model. Then, we tested our testing dataset in this model. When the accuracy of the test set is close to that of the training set, it indicates that we have constructed a reliable model. We have total 5050 data of different individual in our dataset.

V. CONCLUSION

While DR cannot be cured, it is important to detect it in its early stages to prevent further damage. For example, non-proliferative DR stages will almost always contain early indicators of DR and the ability to detect and classify those stages using a proper evaluation technique could mean saving one's eyesight. Diabetes influences various pieces of the body, for example, anxious framework, retina, and kidney prompting loss of the human's organs. From now on, the identification of diabetic retinopathy will be enhanced by using CNN and channels. The detailed accuracy of the representation demonstrated that the suggested design is robust and the implementation of the proposed system is effective. Because of the efficiency of Deep Learning techniques, the analysis of retinal scans has become faster, more inclusive, and generalizable, yet the metrics used in the evaluation of the results and their respective datasets remain biased and unbalanced across different studies. Ultimately, classifying DR is crucial, but understanding the various causes can also be a valid research opportunity.

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