# “Diabetic Retinopathy Detection using VGG-16, CNN”

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**Abstract** - Diabetic Retinopathy is a serious eye illness that can prompt visual deficiency on the off chance that is not distinguished in the beginning phases, and keeping in mind that manual determination by specialists is inclined to mistakes, PC vision-based strategies have been proposed to consequently recognize DR and its stages from retina pictures, with the proposed CNN model prepared on a Kaggle dataset effectively further developing characterization precision by catching rich elements and identifying all phases of DR.

**Index Terms** - Diabetic Retinopathy (DR), Retinal Images, Machine learning, Neural network, feature extraction, filters, pool layer.

## I. Introduction

Diabetes is a constant illness that happens when the body cannot handle blood glucose appropriately, leading to a range of organ damage including the heart, blood vessels, kidneys, nerves, and retina. Diabetic retinopathy is the most common diabetic eye disease that can result in blindness, with nearly 415 million diabetic patients at risk. This disease has two main stages: non-proliferative diabetic retinopathy (NPDR), which can be cured if detected early, and proliferative diabetic retinopathy (PDR), which cannot be cured and can lead to permanent blindness. However, manual detection of Diabetic Retinopathy is tedious and time-consuming, requiring trained clinicians to analyze color fundus photographs of the retina, which can lead to delayed diagnosis and treatment.

## II. Literature survey

### 1. Detection of blood vessels in retinal images using two-dimensional matched FILTERS [1]

**Goal:** Detection of bold vessels in retinal images.
**Method:** Edge detection in image processing applications and implementation of a 2-D matched filter kernel in a grid.
**Result:** Analyze fluorescein angiogram images of the retina.

### 2. Automated detection and classification of vascular abnormalities in diabetic retinopathy [2]

**Goal:** Automated detection of vascular changes that are seen clearly in the moderate to severe stages in DR.
**Method:** The vascular abnormalities are detected using scale and orientation-selective Gabar filter banks.
**Result:** Classifies the retinal image as mild as severe case based on the output obtained from Gaborr filters.

### 3. An Interpretable Ensemble Deep Learning Model for Diabetic Retinopathy Disease Classification [3]

**Goal:** Automatic image-level DR detection system using multiple well-trained deep learning models.
**Method:**
Fundus image datasets collection
Image pre-processing and data augmentation
Model selection and training
Ensemble learning based on the Adaboost algorithm
**Result:** Proposed an interpretable Dr screening method based on multiple deep learning models.

## III. Proposed Methodology

To detect retinopathy in fundus images using machine learning, several steps are involved, including converting the image to a suitable input format, applying noise-canceling, and various preprocessing techniques. The model is then trained on a training set and assessed on a testing set to evaluate its exhibition of concealed information.

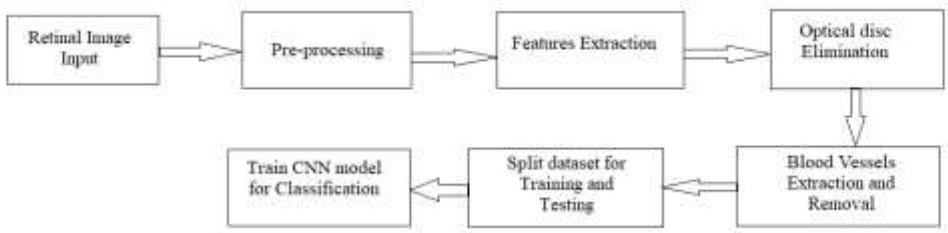


Fig 1: Architecture of Diabetic Retinopathy Detection using CNN

*(1) Preprocessing*

During the preprocessing stage, the input image (Fig 2) undergoes several steps to correct issues such as blurring, non-clarity, and an incorrect size. The first step involves rescaling the image, followed by color space conversion, image regeneration, and image magnification. The resulting-colored fundus image is then converted into the HSI (hue, saturation, and intensity) model, as shown in Fig 3. In this model, the intensity component and color model space are separated from the color image, allowing for more effective processing.

Fig 2: Original Image

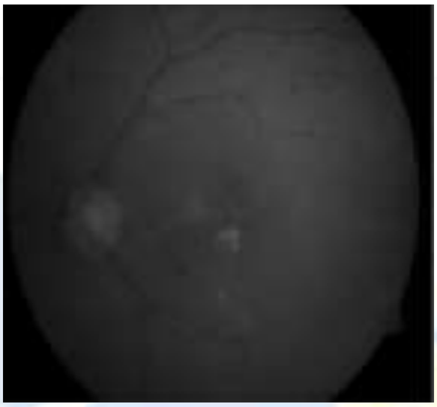

Fig 3: HIS Model image

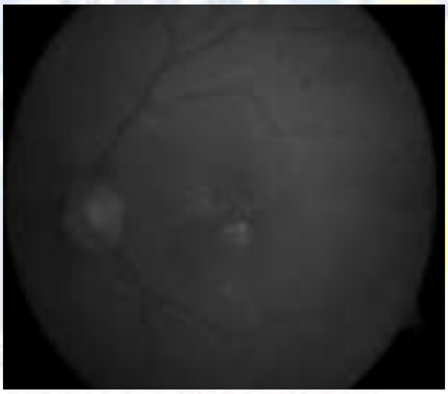

Fig 4: Pre-processed image

(2) *Features extraction*

Morphological operations such as erosion, dilation, closing, and opening can be applied for candidate extraction in medical image analysis, especially in the detection of features such as micro-aneurysms and exudates in retinal images. These operations involve modifying the shape and structure of the image to enhance certain features, remove noise, or segment the image into different regions of interest. For instance, dilation can be used to enhance and enlarge features of interest, while erosion can be used to remove small features or noise. Closing and opening operations can be used to fill gaps and remove holes in the image, respectively. These morphological operations are useful in the pre-processing and feature extraction stages of image analysis.

(3) *Optical disc elimination*

In retinal image analysis, the optical disc (OD) can be a bright and prominent feature in the fundus image and can interfere with the detection of other features like exudates. Therefore, it is common practice to mask and remove the OD from the retinal image.

One approach to removing the OD is to use image processing techniques like region properties and area finding to identify and mask the region corresponding to the OD. Edge detection algorithms like Vigilant can be utilized to distinguish the edges or limits of articles in a picture, remembering the OD for retinal pictures. The Canny edge detection algorithm works by finding the edges in an image where the intensity changes rapidly.

(4) *Blood vessel extraction and removal*

The use of morphological operations like dilation and structuring elements is an effective way to remove blood vessels and the optical disc from retinal images. By dilating the intensity image, high-contrast blood vessels can be removed, and small holes can be filled using structuring elements like a flat disc shape. This is important because blood vessels have a similar concentration level as microaneurysms and exudates, and the optical disc can interfere with the detection of other features. Additionally, the use of a structuring element starting from black pixels allows for the creation of boundaries of objects in the fundus image. Overall, these operations can improve the accuracy and reliability of microaneurysm and exudate detection in retinal images.

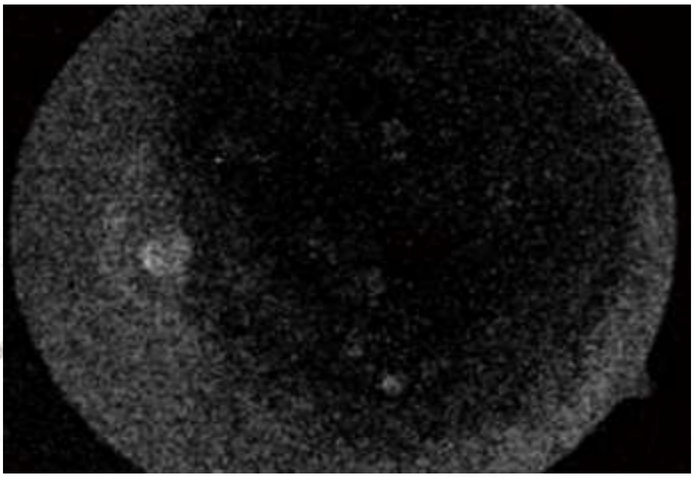

Fig 5: Blood Vessels Removed Image

Fig 6: Exudates Features

## IV. RESULTS

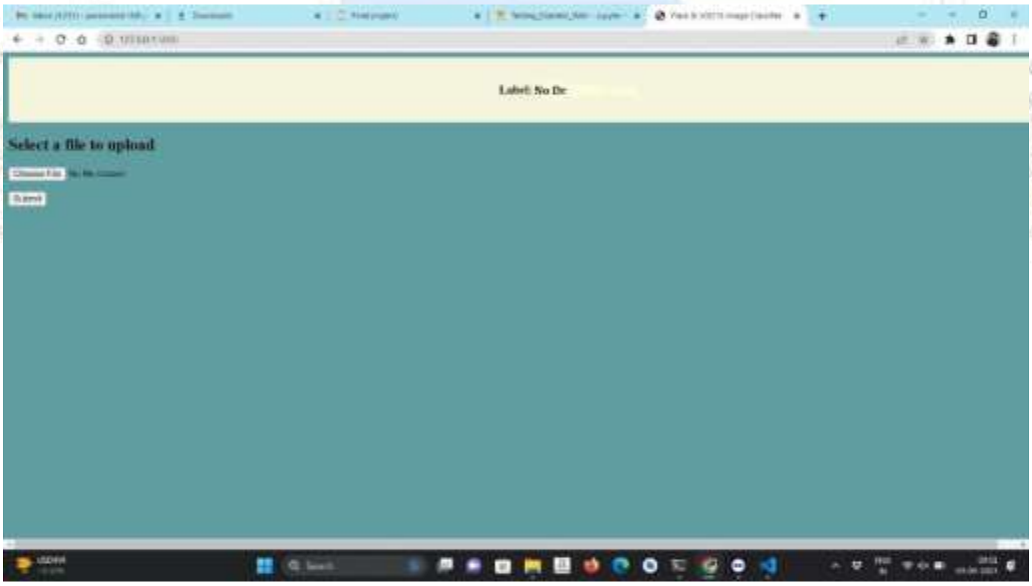


Fig 7: This indicates there is no Diabetic Retinopathy

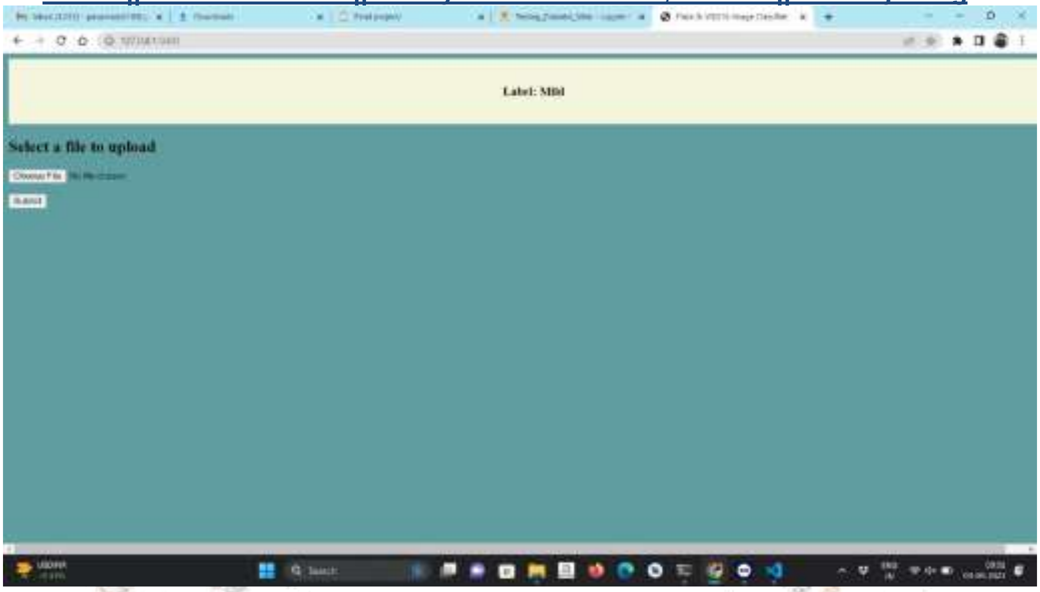


Fig 8: This indicates a Mild stage of Diabetic Retinopathy

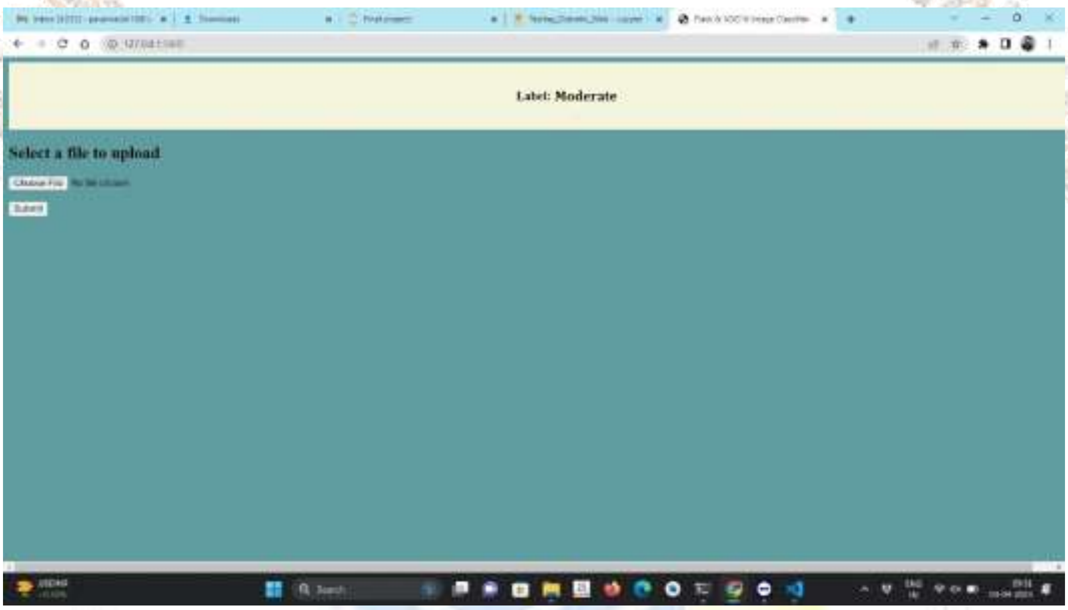


Fig 9: This indicates a Moderate stage of Diabetic Retinopathy

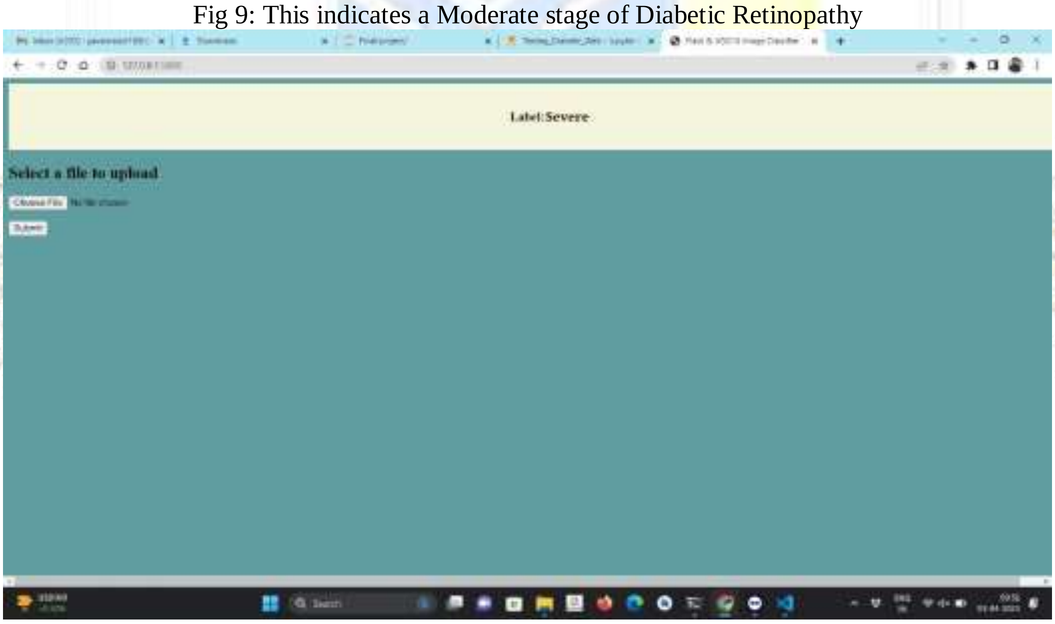


Fig 10: This indicates a Severe stage of Diabetic Retinopathy

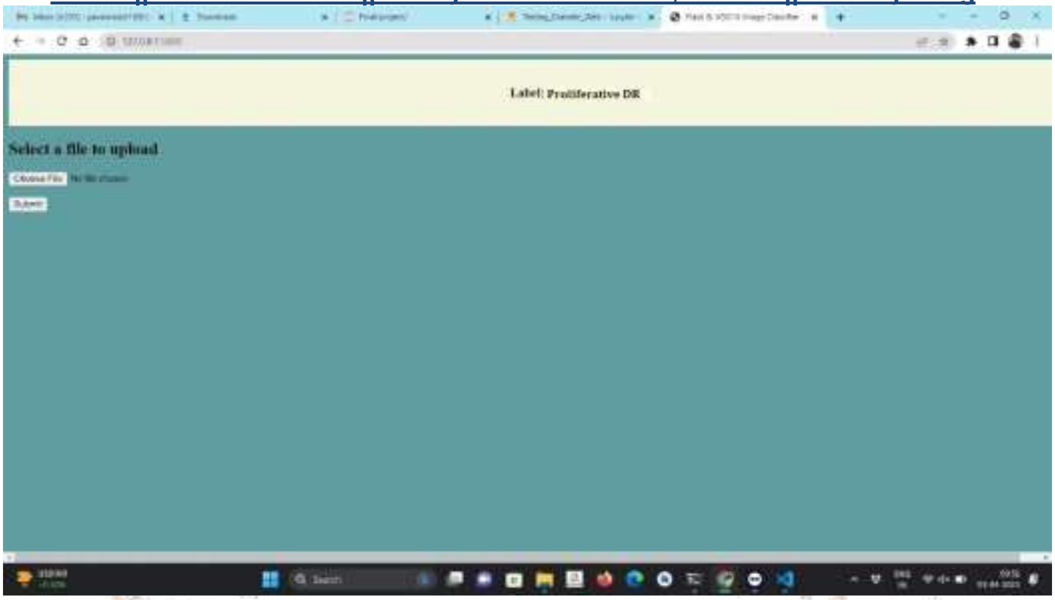


Fig 11: This indicates the Proliferative stage of Diabetic Retinopathy which may lead to blindness

## V. CONCLUSION

Diabetic Retinopathy is an illness that causes vision misfortune quickly. Pre-processing methods like Grayscale change, Versatile Histogram Balance, Discrete Wavelet Change, Matched channel Reaction, and Fluffy C-implies division are applied to the information variety of retinal pictures. In the wake of applying these pre-handling strategies, the nature of the pictures is moved along. From the pre-handled pictures, highlights were extricated for the grouping system. As an accomplishment of this work, the DR has been ordered into two classes: NPDR and PDR utilizing VGG-16, and CNN. This method utilized for the order was great in execution. Consequently, this work has given a fruitful Diabetic Retinopathy Diagnosing technique that assists with diagnosing the illness in the beginning phase, which commonly lessens the manual work. Trial results show that CNN has a precision of 97.37 %.

This surmises that the CNN model beat any remaining models. Likewise, our framework is run on 1164 pictures accessible from "Kaggle: Assessment Information base and Philosophy for Diabetic Retinopathy" and the outcomes show that CNN has an exactness of 97.37%. In any case, we can work on the productivity of the right grouping by extricating better elements and by expanding how much information there is in each class, and furthermore, by joining it with other example arrangement models.

## VI. REFERENCES

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