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DETECTION OF RETINOPATHY AND SEVERITY LEVEL CLASSIFICATION

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Abstract- Diabetic Retinopathy is one of the most common diseases faced by diabetic patients, which contributes to the primary cause of blindness. Since DR does not initially develop any symptoms, multiple physical examinations, like as pupil dilation, visual acuity tests, and others, are required for DR illness identification. Thus, it is important to classify the types and stages of DR in order to provide appropriate care. So, for this, our proposed work is DCNN algorithm which is a deep learning technique that helps for DR detection and severity level classification of DR based on color fundus images. Our proposed model makes CNN into advanced CNN by including featured algorithms like Resnet, InceptionV3Network and ultimately the output will be not only the classification of severity levels but also the comparative study among raw CNN, Resnet and Inceptionv3Network will be given by our proposed model.

Key words: DCNN, CNN, Diabetic Retinopathy, Illness identification, Resnet, Inceptionv3Network.

1. Introduction

Diabetes mellitus causes diabetic retinopathy, which is a passive disease. It has a number of negative impacts on the naked eye that, if not addressed, might result in blindness. It took multiple surgeries to heal and restore the eye after it became infected. This concept simplifies things by preventing illness spread by diagnosing the infection as soon as feasible and administering the necessary medication. The model uses a powerful algorithm to precisely determine the phases and infection. As a result, the model aids in recognizing and informing about the patient's infection level. This is a user-friendly model in which the trained data set runs the deep learning algorithm to determine the degree of infection in the eye. RETINOPATHY: DIABETIC DISORDER Diabetes is one of the world's most debilitating diseases. Diabetes mellitus affects the majority of the elderly population. The increase in sugar levels in the body causes a slew of horrible diseases. It also reduces the body's inherent strength. Diabetes causes a slew of additional serious illnesses. Diabetic Retinopathy is one such condition caused by diabetes mellitus. Diabetic retinopathy is caused by high blood sugar levels. It is a condition in which the eye sight gradually deteriorates until it completely disappears at one point. Diabetic retinopathy is a vision problem caused by diabetes. It can occur as a consequence of diabetes-related high sugar levels. Too much level of glucose can affect blood vessels in the eyes, including those in the retina, over time. The retina is the layer of tissue that covers the back part of the eye. It senses light and transmits information to the brain via the optic nerve. Sugar can cause the retina's small blood vessels to leak or bleed if it obstructs them. The eye may then develop new blood vessels that are weaker and more likely to leak or hemorrhage.

DIABETIC RETINOPATHY CAUSES:

Diabetes causes elevated blood sugar, which leads to diabetic retinopathy. Too much sugar in your blood can damage your retina, which detects light and transmits information to your brain through some kind of nerve at the back of your eye, over time (optic nerve). Diabetes wreaks havoc on the body's blood vessels.

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Sugar obstructs the nerves and blood vessels that lead to your retina, forcing them to ooze fluid or bleed, causing damage to your eyes. Your eyes generate new blood vessels that don't operate adequately to compensate for the blocked blood vessels. These young blood vessels are prone to leaking or bleeding.

2. Existing System

The existing systems are based on Neural Networks which make them slow and prone to lags. The accuracy of the models is less, which makes them unreliable for real-time implementation. The existing system also draws huge computational power which makes them expensive and difficult to maintain. The existing system works on outdated ml algorithms. The existing system has less accuracy. The existing system has consumed more power so maintaining is difficult.

3. Proposed System

The proposed system is based on Convolutional Neural Networks, which make them fast and less prone to lags. The accuracy of the models are comparatively high, which makes them reliable for real-time implementation. The proposed system is used to detect presence of retinopathy even at early stages unlike other algorithms. The proposed system is cost efficient manner. The proposed system is developed from the updated ML algorithms so it's simple and easy. It starts with taking input image from the user which is a retinal image and will pre-process it to get more accuracy. From that refined image we apply algorithms and finally compare the accuracies and severity level classification. The proposed system is using a CNN, DCNN which is a comparative study used to find the efficient and accurate output.

COMPLICATIONS:

Diabetic retinopathy is characterized by abnormal blood vessel development in the retina. Serious vision difficulties can arise as a result of complications:

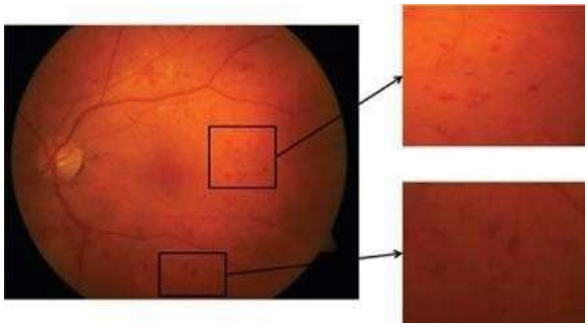

Figure 1: Enlarged Retinal Images indicating bigger red hemorrhage in the eyes of the patient.

Vitreous hemorrhage is a condition in figure (1) that affects the eyes. It's possible that the new blood vessels will leak into the transparent, jelly-like fluid that fills your eye's center. Only just few dark patches may appear if the volume of bleed is minor (floaters). Blood can fill the vitreous cavity and entirely obstruct your vision in more severe cases. In most cases, a vitreous hemorrhage does not result in permanent visual loss. Within a few weeks or months, the blood in the eye usually clears. The vision might restore to its previous sharpness if your retina is not damaged.

Detachment of the retina: Diabetic retinopathy causes aberrant blood vessels to form, causing scar tissue to grow and drag the retina away from the back of the eye. This can result in floating dots in your vision, bright flashes, or serious vision loss.

Glaucoma: It is a disease that affects the eyes. New vessels may form in the front of your eye, obstructing the usual flow of the fluid out of the eye and causing pressure to build up in the eye (glaucoma). The nerve that transmits images from your eye to your brain can be damaged.

METHODOLOGY:

- The fundus image is uploaded to the system.
- The pre-processor converts the fundus image into binary image.
- The colour is extracted in the feature extraction process.
- The output image is classified and the output is determined.

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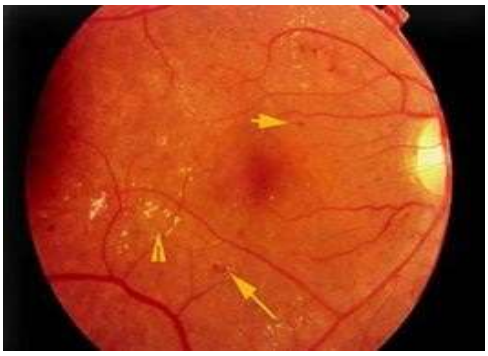

Fig 2. Fundus image

Preprocessor converts the Fundus Image into Binary Image:

In retinal images, grayscale means that the value of each pixel represents only the intensity information of the light. Such images typically display only the darkest black to the brightest white. In other words, the color of image will be in gray color which has multiple levels. Second, the features are extracted using a deep ensemblemodel include InceptionV3, ResNet101, and inceptionv3 from the retinal fundus images. Then, these features are combined to create an ample feature space. To reduce the feature space, we propose four-step feature selection techniques: minimum redundancy, maximum relevance, Chi-Square,

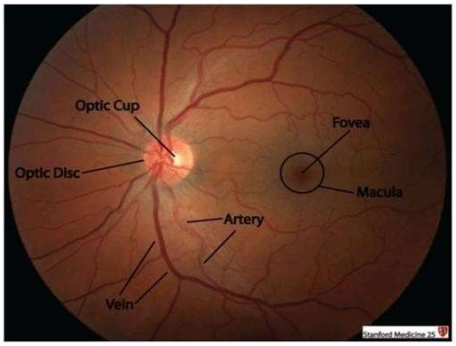

Fig 3. Binary Image

ReliefF, and F test for selecting efficient features. Further, appropriate features are chosen from the majority voting techniques to reduce the computational complexity.

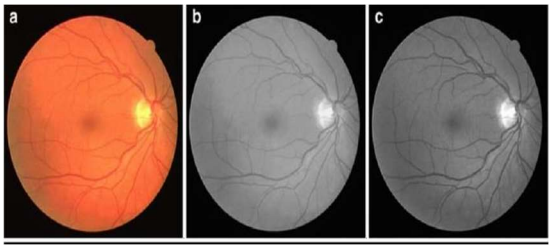

Fig 4. Binary Image

Feature Extraction: Further, the feature extraction phase is started, which tends to extract four sets of features like Local Binary Pattern,Texture Energy Measurement, Shanon's and Kapur's entropy. Since the length of the feature vector seems to be long, the feature selection process is done, which selects the unique features with less correlation.It refers to process of extracting blood vessels. The raw data is converted into numeric data, by taking those numeric values into consideration it is given as input for classification using CNN.

Finally, the effectual performance and comparative analysis prove the stable and reliable performance of the proposed model over existing models. The performance of the proposed model is compared with the existing classifiers such as SVM, Decision Tree etc and metrics like training, testing losses are identified.

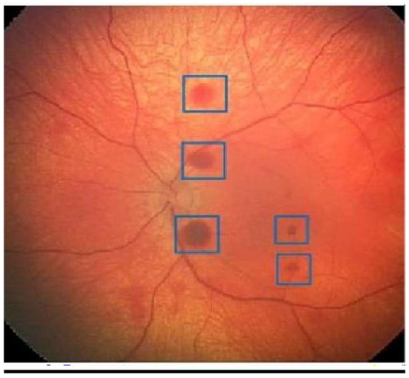

Fig 5. Feature Extraction

When the blood clots bursts, a white layer will be formed which leads to the vision loss for the patients. So, our proposed work primarily identifies all the blood clots as feature and the algorithms classify them by their severity.

IMPLEMENTATION

Diabetes Retinography Analysis:

Diabetes is majorly classified as one of the dreadful diseases of the world. Most of the aged people are getting affected by diabetes mellitus. The rise of sugar content in the body leads to many dreadful disorders. It also decreases the natural strength of the body. The other diseases caused due to the diabetes are severe. One such disorder caused by diabetes mellitus is called as Diabetic Retinopathy. The high sugar level leads to diabetic retinopathy. It is a disorder where the eye sight reduces stage by stage and at one stage the entire eye sight goes off. This is one of the major issues caused by diabetes and can be cured by taking care of it at the early stages.

Diabetic retinopathy is a type of eye disease caused due to diabetes. This will affect the eye of a person. People who suffer from diabetes are prone to eye disease known as diabetic retinopathy which increases high blood sugar levels. Retina is the part of our eye that detects light and sends signals to the brain through a nerve in the back of our eyes and it is known as optic nerve. Damage to the eye starts when the sugar level blocks the tiny blood vessels that connect to the retina. Sometimes the blood vessels can leak and swell. Normally new blood vessels will grow in eyes to replace the blocked blood vessels. But these will not work well all the time and may even bleed again.

Description: We will create a flask app that takes diabetes retina cells and classify the diabetes cell class using Residual Neural Network.

Input: Diabetes Retinography images.

Output: Classes for diabetes cells.

In the process of extracting blood vessels, the raw data is converted into numeric data, and based on that data, identification of DR will be done

Module 1: Dataset Acquisition and Preprocessing

Dataset acquisition:

We will gather dataset from internet containing images of the diabetes cells. In our project, a couple of the photographs from Google were also included in the dataset for images and videos, which was gathered from a website like Kaggle. We will collect image data from kaggle of pests that infected plants. To increase accuracy and robustness, the classification model's input dataset is preprocessed before being employed. All kinds of image input are supported by the model.

Following the collection of all the photographs, the preprocessing procedure begins with the removal of any car images that the system does not require.

Data Preprocessing:

Making data more meaningful and informative is the effort of changing it from a given form to one that is considerably more useable and desired. This entire process can be automated using Machine Learning algorithms, mathematical modelling, and statistical expertise. Depending on the task we are conducting and the needs of the machine, the output of this entire process can be in any desired form, including graphs, movies, charts, tables, photos, and many more.

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GRAPHICAL REPRESENTATION -

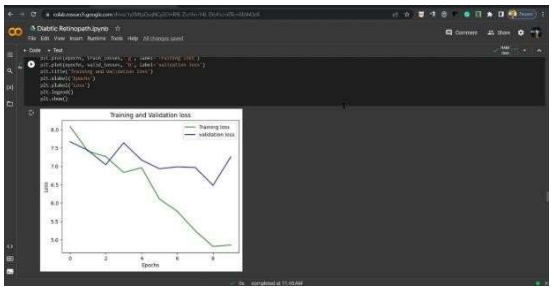

Fig **6**. **Training & Validation Loss**

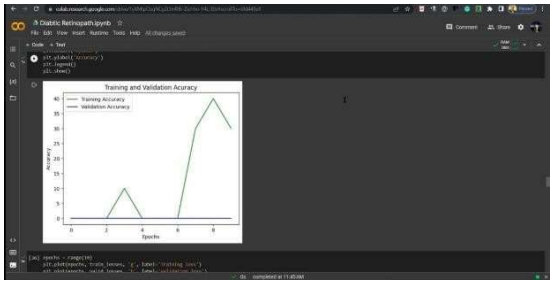

Fig **7**. **Training & Validation Accuracy**

RESULTS –

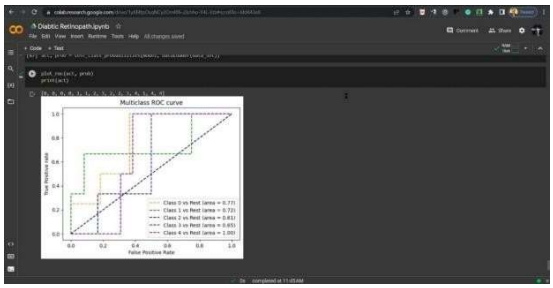

Fig **8**. **Multi Class ROC Curve**

Fig 9. Distribution of Datasets into output Classes

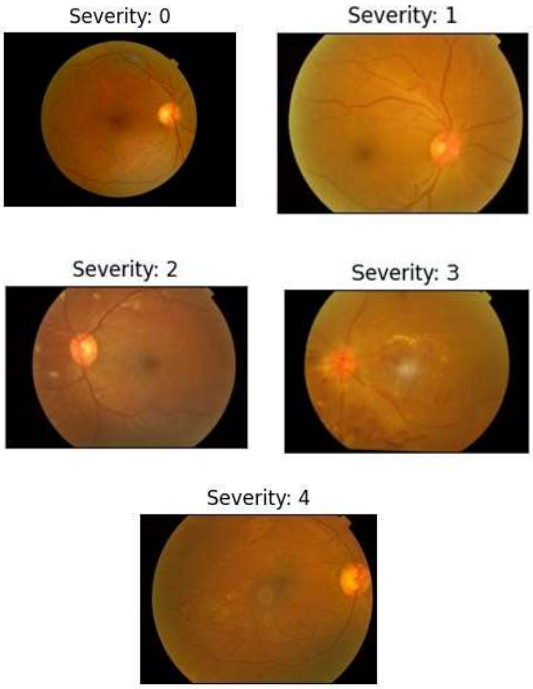

Fig 10 The above figures represents the Output Classes of the Dataset which has its Severity Levels , which represent the Stages of the Retinopathy Disease.

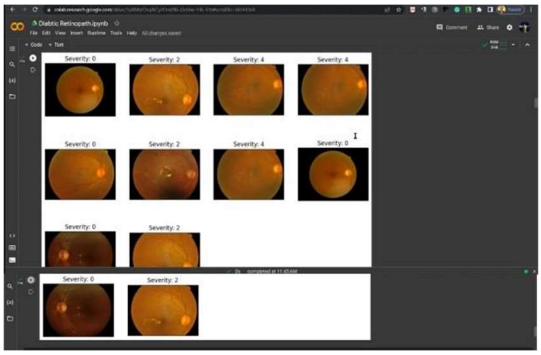

Fig 10. Screen Output

CONCLUSION -

Our proposed work is DCNN algorithm which is a deep learning technique that helps for DR detection and severity level classification of DR based on color fundus images. Other algorithms like CNN are also used previously for DR Detection but they were not able to detect it at early stages and accuracy was not too good. Our proposed model makes CNN into advanced CNN by including featured algorithms like Resnet, InceptionV3Network and ultimately the output will be not only the classification of severity levels but also the comparative study among raw CNN, Resnet and Inceptionv3Network will be given by our proposed model.

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