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IDENTIFICATION AND CLASSIFICATION OF DIABETIC RETINOPATHY USING NEURAL NETWORK APPROACHES

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ABSTRACT
Long-term diabetes can induce DR, an eye abnormality. As the disease worsens, it causes mutilation and blurred eyesight. It is a difficult and time-consuming task to analyze DR using a shaded funds picture since it takes skilled doctors to determine the existence of fundamental highlights. We suggest using CNN to analyze DR from computerized funds images. In our study, we adopted a different technique where the entire image was divided into portions, and only the areas of interest were taken for additional processing. The suggested framework clarifies DR and helps the client get in touch with a specific expert. This enables the client to determine their inquiry and receives an appropriate membership related to medical issues.
Keywords— CNN, Retinal Image, Matrix, Diabetic Retinopathy (DR);

I. INTRODUCTION

Today, DR is identified with a dilated eye exam, in which doctors administer eye drops in the patient's eyes. After that, an image of the eye is taken using a range of medical tools. Since this procedure is manual, some diagnostic mistakes will always occur. Diabetes-related retinal damage (DR), often known as diabetic eye illness occurs when the retina is harmed. In the end, it can result in visual impairment. It is the outward manifestation of diabetes, a fundamental illness that affects up to 80% of all people who have had the disease for at least a decade. Despite these alarming revelations, research indicates that if proper and cautious treatment were provided, the number of these new cases might be reduced by about 90%.The more extended an individual has diabetes, the higher their possibilities creating DR.

DR is a consequence of diabetes that damages the eyes. DR is caused by damage to the blood vessels in the light-sensitive tissue of the retina. Diabetic retinopathy is one of the leading causes of blindness in working-age people. Diabetes mellitus affects around 420 million people globally. In the last 20 years, the prevalence of this condition has risen, particularly in Asia. DR, a chronic eye condition that can cause vision loss, is predicted to be identified in roughly one-third of the population. The importance of DR stage classification depending on the extremities for proper treatment and prevention of vision loss cannot be overstated.

DR can be categorized into five stages, according to the Study of Early Treatment Diabetic Retinopathy. [8].

The review for programmed recognition of DR turns out to be an ever increasing number of essential in the beyond couple of years. In our review we are zeroing in on irregularities in the retina as exudates and red injuries. Because of the comparative shading attributes of red sores with the retinal veins it is difficult to find these injuries utilizing typical picture handling procedures. DR is an infection of the retina in persons who have diabetes. It is started as a result of long-term retinal vascular damage induced by diabetes mellitus [13]. One of the most common causes of blindness is this disease [2]. As a result, detecting it at an early stage is crucial.

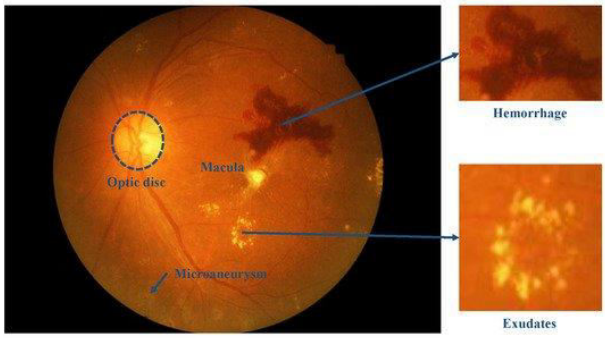

Figure 1. Early pathological signs of DR

The vessels might become broken shaping yellow white specks which are usually alluded to as exudates. The principle issue with DR is that it doesn't for the most part cause sight misfortune until it has arrived at the high level stage. Because of the absence of any huge manifestations ordinary DR screening will just assist the patients with high gamble of movement. To recognize DR we dissect the fundus pictures for the sores and exudates. Typical methodology for diagnosing DR is tedious and requires experienced clinicians to recognize basic elements from the fundus pictures. A programmed technique for identification of DR would assist individuals with diabetes to perceive the manifestations at its prior stage. It can significantly decrease the clinical weight on retina trained professionals. This additionally assists with observing the elements of the sores. Nations with gigantic populace like India, China, Indonesia and Bangladesh adds to 45% of the worldwide weight in diabetes since the counts are relied upon to climb, a programmed clinical recognition would be of much assistance.

II.MOTIVATION

Diabetes mellitus is a major public health issue around the world, with more than 75% of patients with diabetes mellitus for more than 20 years developing retinopathy. Diabetic retinopathy is linked to the duration of diabetes, therefore as life expectancy rises, diabetic retinopathy and the risk of blindness rises as well. According to the WHO, figure 1.3 depicts the number of people with diabetes in 2000 and the predicted growth in 2030. Diabetes mellitus is a rapidly spreading disease in India, with about 62 million patients of various ages affected. In the year 2000, India ranked first, with 31.7 million diabetics, and this figure is expected to rise to around 79.4 million by 2030. The only method to detect early DR symptoms is to keep a close eye on them. Early intervention may reduce the risk of vision loss or blindness.

III. LITERATURE SURVEY

Nikos Tsiknakis et.al [1] Diabetes mellitus causes diabetic retinopathy, which is the primary cause of blindness worldwide. To postpone or avoid vision degradation and loss, early detection and treatment are required. To that goal, numerous artificial intelligence-powered methods for detecting and classifying DR on fundus retina images have been proposed by the research community. This review article examines the application of deep learning approaches in the diabetic retinopathy detection pipeline based on fundus pictures at various stages.

M. Mohsin Butt et.al [2] The fundus cope produces images that disclose information about the eye's fundus. These fundus photographs show the retina's internal structure and optic disc part. The diagnosis of DR is a manual procedure that needs the doctor to carefully examine and assess digital color fundus photographs of the retina. DR can have a variety of adverse effects.

San-Li Yi et.al [3] Early detection and proper diagnosis of DR are critical for avoiding blindness, and employing deep learning approaches to automatically diagnose DR has sparked considerable interest. However, the little amount of DR data available restricts its use.

Gao Jinfeng et.al [4] DR is an eye illness that causes damage to the eye's blood vessels. If not identified early enough, DR can result in impaired vision or even blindness. DR is divided into five stages: normal, mild, moderate, severe, and PDR. Traditionally, several hands-on computer vision projects have been used to

identify DR, but they are unable to code the intricate underlying features, resulting in poor classification of DR stages, particularly early stages. Using balanced and imbalanced datasets, two deep CNN models using an ensemble technique were suggested in this study to detect all stages of DR.

Kang Zhou et.al [5] In patients with Diabetes Mellitus, DR is a serious eye illness, and an automatic retinal image processing technique for DR screening is in great demand. Given the high resolution of retinal images, where small pathological tissues can only be detected with high resolution images and a large local receptive field is required to identify late-stage disease, but directly training a neural network with very deep architecture and high resolution image is both time computationally expensive and difficult due to the gradient vanishing/exploding problem, they propose a Multi-Cell architecture that gradually improving quality Furthermore, because the various stages of DR advance in stages, the labels of the various stages are connected.

Sahil Chelaramani et.al [6] while accurate disease prediction from retinal fundus pictures is important, gathering huge volumes of high-quality labeled training data to develop supervised algorithms is difficult. Deep learning classifiers have shown high-accuracy outcomes in a range of medical imaging situations, but they require a lot of labeled data.

Zhen Ling Teo et.al [7] Most studies used the Early Treatment Diabetic Retinopathy Study classification or the American Association of Ophthalmology International Clinical Diabetic Retinopathy Disease Severity Scale.

Nikhil M N1 et.al [8] Stage classification is an important step in the evaluation and treatment of DR. Microstructures such as micro aneurysms, hard exudates, and neovascularization may develop in the retina as a result of blood vessel injury. To automate the procedure of DR stage categorization, a CNN (Convolutional Neural Network) based methodology might be utilized. DR is divided into five stages using a CNN in this study based on color fundus retinal pictures. Images with DR are divided into five categories based on the judgment of an ophthalmology expert.

Prasanna Porwal et.al [9] DR is the most common cause of preventable visual impairment, mostly impacting the world's working-age population. Recent research has improved our awareness of the need in clinical eye care practice to find better and less expensive approaches to detect, manage, diagnose, and treat retinal illness. The relevance of DR screening programmers, as well as the difficulties of obtaining reliable early DR diagnosis at a reasonable cost, necessitates the development of a computer-aided diagnosis tool. Computer-assisted disease detection in retinal image processing could make mass screening of diabetic populations easier and help doctors make better use of their time.

Y. Sravani Devi, et.al [10] only a medical eye examination can diagnose DR, and it is asymptotic. As a result, early detection of DR is critical in order to significantly prevent visual loss. Diabetic patients' future vision loss is also prevented by early detection and advancement of the disease. Nonetheless, early screening is not guaranteed due to a shortage of ophthalmologists, which results in long wait periods, particularly in developed countries. Furthermore, patient mobility, particularly in aged patients, is a limiting factor.

Sharmin Majumder et.al [11] This work introduces a multitask deep learning model that can detect all five stages of DR: no DR, mild DR, moderate DR, severe DR, and proliferating DR. One classification model and one regression model, each with its own loss function, make up this multitask model. Because a higher severity level usually follows a lower severity level, the classification and regression models are combined to account for this reliance..

Oindrila Saha et.al [12] The lack of statistically meaningful amounts of labeled data is a major barrier in developing data-driven inference models. Because datasets are often created for a specific purpose, they are only weakly labeled for a single class rather than being fully annotated. Despite the fact that there are several datasets that together comprise a big corpus, their poor labeling makes direct use difficult.

Hassan Tariq et.al [13] DR is a human eye condition that affects diabetics. It harms their eyes, resulting in visual loss. It can be

treated, but it takes a long time to diagnose and may necessitate numerous eye tests. Early detection of DR has the potential to prevent or delay visual loss. As a result, a reliable, automatic, and computer-based diagnosis of DR is required. Deep neural networks are currently being used to identify various disorders in a variety of medical fields.

Ajay S .Ladkat et.al [14] DR is an eye condition in which the patient's retina is impacted by an increase in insulin levels in the blood. The symptoms can cause the patient's eyesight to be distorted or blurred, resulting in blindness. We must first distinguish between exudate and no exudate pixels in order to detect exudates automatically.

Ajay S .Ladkat et.al [15] Each pixel must be processed separately for picture processing. This operation will take too long if carried out successively. As a result, parallel processing on all pixels is required to decrease the time. As a result, rather than working on each pixel individually, operations on all pixels are performed simultaneously. When compared to sequential processing, the speed of parallel processes is greatly boosted. As a result, it will aid in the speedier processing of video. NVIDIA Graphics card is utilized for parallel computing. The CUDAC platform is used to run the parallel algorithm.

IV.PROBLEM STATEMENT

For decades, diabetic retinopathy has been the major cause of blindness. Retinal impairment has affected practically the entire population, and it has proven to be a severe case of diabetes. However, research reveals that if there were effective strategies to address this, 90 percent of cases might be reduced significantly. These include early discovery and aggressive treatment, as well as careful eye surveillance. Diabetic Retinopathy is more likely to develop as time goes on when you have diabetes. Blurred vision, sudden loss of vision in one eye, visions of rings around lights, black areas, or flashing lights are some of the symptoms. Micro aneurysms, enlarged retina, leaky blood vessels, formation of atypical blood vessels, and nerve tissue impairment are also identifiers of DR. In recent years, CNN have proven to be superior to traditional methods in classification and object identification tasks. In this research, we present various CNN transfer learning algorithms and will conduct a comparative analysis among them, leveraging data preprocessing, to determine which of these models is the most successful at detecting DR. However, one of the main issues with the majority of CNN techniques for DR classification is that they process the input data without taking into account that while most sections of the retina images are unrelated to DR, other segments of the input image have a greater impact on the image's final label.

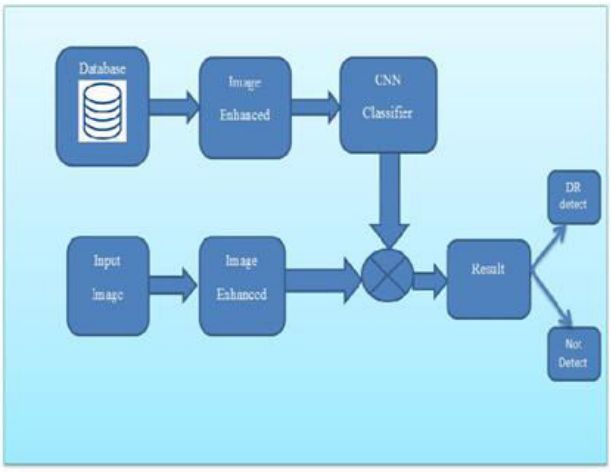

Figure.2. Architecture of proposed system

Our proposed methodology is adaptable and detects the categorized images of patients with greater precision. It divides the data into stages/categories based on the severity of the ailment. It also assists clinicians with choosing one or more CNN architectures for diagnosis. CNN has been broadly perceived for applications, for example, picture handling, design acknowledgment and video acknowledgment. CNN in picture order accepts a picture as the information and characterize it into the fitting classification. It has various secret layers in which convolution is done to extricate highlights and other significant data from the picture. The result is acquired from the grouping layer. In R-CNN, the picture is fragmented into numerous portions and the CNN is constrained to zero in on these sections. The exactness of article location is exceptionally high contrasted with that of CNN because of extraction of locale of interest. At first the first fundus pictures are resized to an element of 336 x 448.Because of the gigantic data and changing differentiation of pictures got from the fundus cameras preprocessing is important. Without preprocessing the pictures experience the ill effects of vignetting impacts and picture twisting. Since the pictures are gotten from various fundus cameras they will have non uniform enlightenment, brightening standardization strategies must be fused.

V. PROPOSED SYSTEM

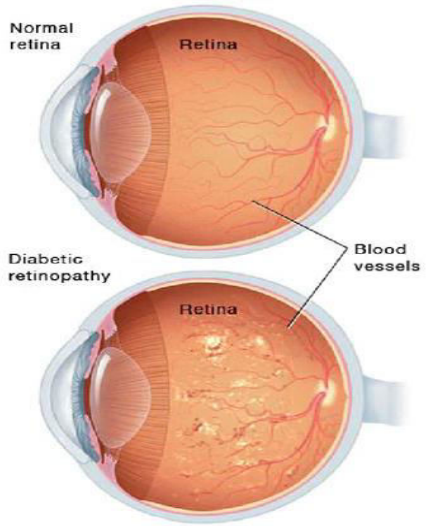

Figure.3. Normal Retina vs. DR

CNN Algorithm

Man-made reasoning has been seeing an amazing development in overcoming any barrier between the abilities of people and machines. Specialists and devotees the same, work on various parts of the field to get astounding things going. One of numerous such regions is the area of Computer Vision.

The plan for this field is to empower machines to see the world as people do, see it along these lines and even utilize the information for a huge number of errands like Image and Video acknowledgment, Image Analysis and Classification, Media Recreation, Recommendation Systems, Natural Language Processing, and so on The progressions in Computer Vision with Deep Learning has been built and consummated with time, fundamentally more than one specific calculation - a Convolution Neural Network.

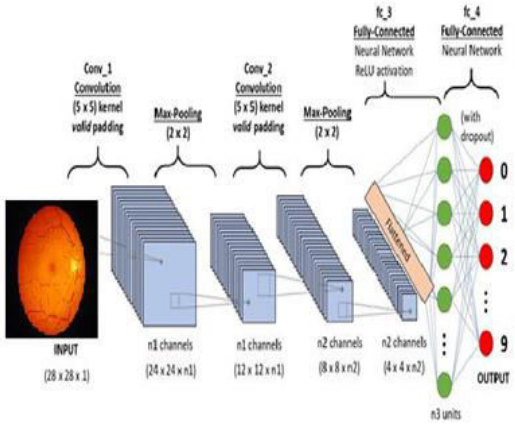

Figure.4. CNN sequence to classify handwritten digits

In comparison to other classification algorithms, ConvNet requires substantially less pre-processing. While basic approaches require hand-engineering of filters, ConvNets can learn these filters/characteristics with enough training. The architecture of a ConvNet is inspired by the organization of the Visual Cortex and is akin to the connectivity pattern of Neurons in the Human Brain. Individual neurons can only respond to stimuli in a

small area of the visual field called the Receptive Field. A group of such fields can be used to cover the full visual field.

i) Database- The images included in the dataset and need to be downloaded from the MESSIDOR dataset: http://www.adcis.net/en/Download-Third-Party/Messidor.html

ii) Pre-processing

Pre-processing images commonly involves removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images. Image pre-processing is the technique of enhancing data images prior to computational processing.

iii) Feature extraction

Feature extraction involves reducing the amount of resources required to describe a large set of data. When performing analysis of complex data one of the major problems stems from the number of variables involved. We are using Wavelet transform to extract features like RMS value, average, entropy of image.

iv) Classification

Image classification refers to the task of extracting information classes from two or many class of image. Features extracted by wavelet transform and by using ultraviolet rays are feed to classifier so that classifier, here CNN algorithm, should be able to classify the normal retina and DR .

VI.RESULTS AND DISCUSSION

Step I: The system receives the retinal image as input, which it then collects and processes.

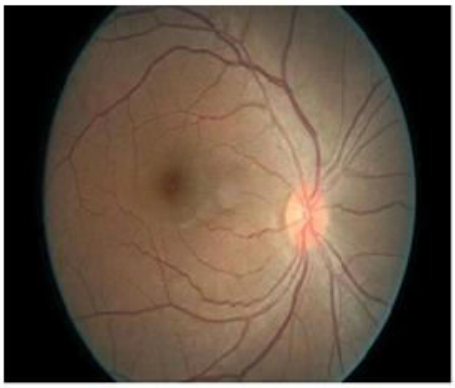

Figure.5. Retinal image

Step II: The system gathers retinal images and separates the red, green, and blue matrix from them. The median filter is then employed to eliminate noise. After that, each matrix is given a spatial filter. Figure 6.2 depicts the spatial filtered result.

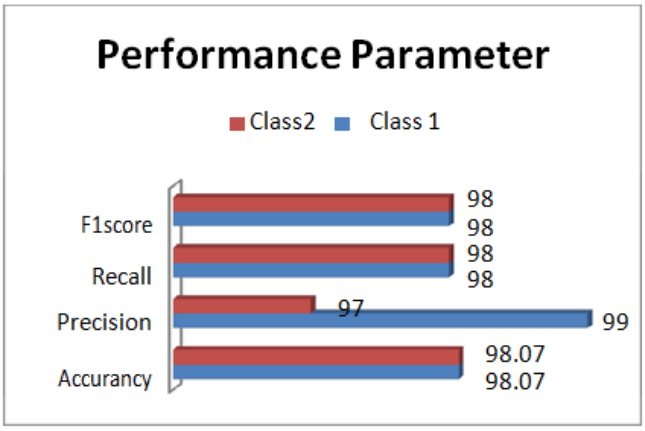

Fig.6. Graphical Representation of accuracy

We produced confusion matrix with given for class 1 as training dataset, totaling 639 photos for classifier, and 8 images will not be detected, as shown in the graph above. At the time of testing for class 2, we provided a total of 429 images to the classifier, with 13 images being rejected. The accuracy of the developed classifier is represented graphically as 98.07 percent.

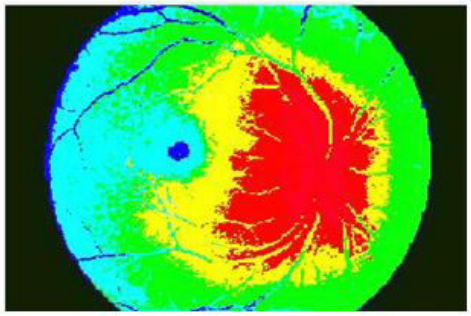

Figure.7. Spatial Filter

Step III: The filtered result is sent to the updated CNN classifier. So, after CNN, we get a better retinal image that tells if the patient is DR or not.

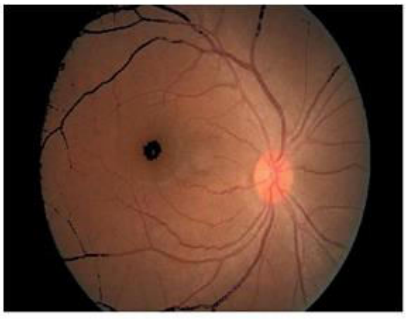

Figure.8. spatial Filter Enhancement as Output Image

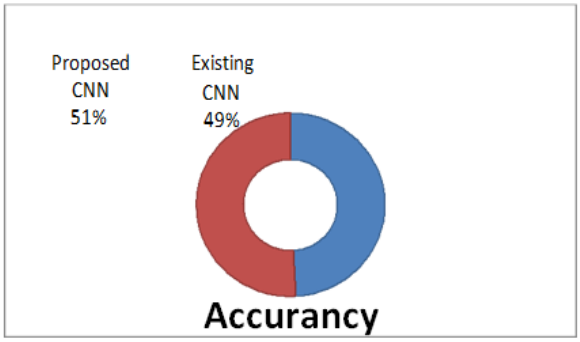

Fig.9. Accuracy over existing system

Our solution is more accurate than the old system and enhances performance efficiency.

CONCLUSION

This study uses deep transfer learning to classify DR patients using CNN. This study created an effective formula for splitting hard exudates. The optic circle is removed using morphological activity and a circular Hough Transform. Exudates and non-exudates pixels are separated using the biggest Entropy and the matched channel. The suggested calculation yields 93.75 percent accuracy at the image level and 99.6182 percent precision at the pixel level. It is useful for determining CNN's seriousness or stages. Doctors and researchers can make better therapeutic judgments with the assistance of our highly accurate data.

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