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Review On Deep Convolutional Neural Network based for Early Recognition of Diabetic Retinopathy

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Abstract- Diabetic retinopathy (DR), a prevalent outcome of diabetes mellitus, causes lesions of the back of the eye that impair vision. If it fails to be detected in time, paralysis could follow. Unfortunately, there is presently no known treatment for DR; the only choice is avoidance. Rapidly reducing the risk of vision loss involves early identification and treatment of DR. DR retina fundus pictures must be manually diagnosed by ophthalmologist, which is more costly, time-consuming, and error-prone than computer-aided diagnosis techniques. Deep learning has recently risen to the top of the list of preferred methods for improving performance, particularly when it comes to classification and decoding of medical images. Convolutional artificial neural networks are being employed in the interpretation of healthcare pictures since they are such an effective learning technique. The most sophisticated methods for classifying and identifying DR colour images of the fundus using algorithms based on deep learning have been examined and analyzed for the reason of this research. Additionally, the colour the fundus retinal DR data have been examined. Additionally, certain difficult problems requiring more research are dealt with.

Keywords— Computer-aided diagnosis Deep learning Diabetic retinopathy Diabetic retinopathy stages Retinal fundus images etc.

I. INTRODUCTION

The leading cause of vision loss in people of working age in industrialized and developing nations is diabetic retinopathy. people with diabetes have a 25 times higher risk of going blind than people without diabetes [1]. A retinal consequence of diabetes is called diabetic retinopathy. Early on, the disease is largely asymptomatic, but if left untreated for an extended period of time, it could result in permanent eyesight loss. The issue here is that the patients might not be aware of it until it has progressed to an advanced stage. Once the condition has advanced, vision loss is unavoidable. It is urgently necessary because diabetes-related retinopathy is the third biggest cause of deafness, particularly in India, it is essential to develop efficient diagnosis methods to treat this issue [1].

High blood sugar levels cause the walls of microscopic blood arteries to swell, which leads to the development of micro-aneurysms. Micro-aneurysms will burst as the condition worsens. This causes retinal hemorrhages in the retina's outer layers or deeper layers [1] (Fig. 1(a)). Along with leaking blood, the arteries also let lipids and proteins out, which contributes to the development of tiny. Diabetes Mellitus (DM) is a medical disorder that can lead to diabetic retinopathy (DR). As a result of the human retina being damaged, it results in vision issues and blindness. Statistics show that DR affects 80% of diabetes patients who have had the disease for 15 to 20 years or longer. As a result, it now poses a serious threat to people's lives and health.

The disease can be manually diagnosed, but doing so would be difficult and time-consuming, making a novel approach necessary to treat DR. Therefore, early detection and diagnosis are necessary to stop DR from progressing into severe stages and to stop blindness. Numerous Machine Learning (ML) methods have been presented by academics from all over the world to do this. Numerous extracted feature algorithms are available for the collection of DR characteristics for early identification. Traditional ML models, however, either exhibit poor generalization during feature extraction and classification for use with smaller datasets or use more training time for poor prediction performance when used with larger datasets. Deep Learning (DL), a new area of machine learning, is thus introduced.

A smaller dataset can be handled by DL models with the aid of effective data processing methods. They do, however, Deep architecture often use larger datasets to enhance the accuracy of feature extraction and classification of images. This study provides a thorough analysis of DR, including its characteristics, root causes, modern DL models, problems, comparisons, and future approaches for DR early detection.

II. PROBLEM IDENTIFICATION

DR infection associated diabetic retinal edoema (EDM) have lately been diagnosed in a sizable percentage of diabetic patients. The most deadly eye disorder, diabetic retinopathy (DR), is brought on by enlarged and fluid-leaking blood vessels in the eyes. Additionally, blood vessels may clog, preventing the fluid from flowing through and leading to the formation of a typical aberrant growth of blood vessels on the cornea. Finally, all of these modifications result in vision loss or possibly blindness.

Ophthalmologists can treat or slow the progression of retinal eye illness by identifying it in its early stages. This prevents patients from losing their vision. The iris, cornea, retina, sclera, nerve fibres, optic nerve, The primary elements of the eye are, etc. Diabetes patients run the risk of developing a condition called retinopathy caused by diabetes, cataracts, obstructions in the retina arteries, and obstructions in the retinal veins, among other disorders. The benign or pre-final phase (NPDR) and are proliferative or final phase (PDR) are the two distinct clinical stages of DR infection. NPDR refers to the initial stage in diabetic fundus disease. When there is NPDR, blood vessels leak, forcing the retina to expand.

The main cause of vision blur and occasional vision loss is this. The second stage of diabetic fundus disease is known as proliferative retinopathy (PDR), and it is the most severe condition. It happens when additional blood vessels start to rise on the cornea. In this instance, it is referred to as the formation of n If the patient bleeds a bit, they might see a few hazy floaters. They could lose all vision if they bleed profusely. The newest blood vessels supplying the eyes in the ocular system can produce tissue scarring.

Central and peripheral vision can be stolen by PDR. As a result, it is essential to find DR as quickly as feasible. A manual detection of DR disease is a significant undertaking that is normally performed by ophthalmologists. The findings of manual identification are difficult to repeat when needed and are subject to human mistake. The suggested framework has the capability of extracting the region of concern and automatically identifying DR in the initial phase, supporting eye doctors in screening patients and clinical studies in addition to reducing human mistakes and processing time as well as enabling quick and highly precise replication of the findings whenever necessary.

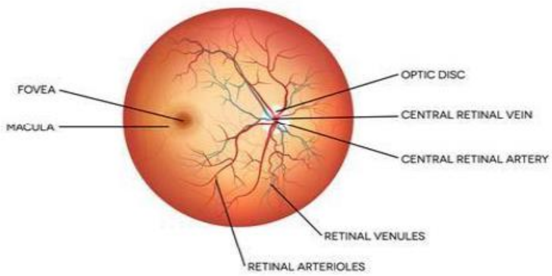

Fig.1. Healthy human retina

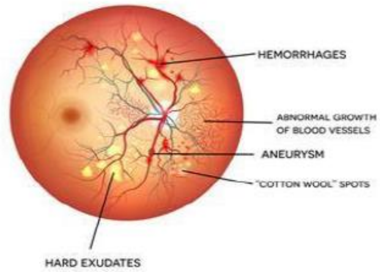

Fig. 2. Affected with DR

III. OBJECTIVE

• The main objective of this paper is to assess the benefits and drawbacks of the numerous earlier studies undertaken for early DR diagnosis.

• Early recognition of the many symptoms of retinal conditions.

• It will appropriately offer a solution at the outset for DR techniques such as feature extraction, division, object recognition, localization, and and picture classification.

IV. LITERATURE SURVEY

There is currently growing interest in developing automated systems that screen a large number of people for diseases like diabetic retinopathy that can jeopardise their vision and provide an automated detection of the condition. Numerous instances of the use of digital imaging techniques for detecting diabetic retinopathy may be found in this literature review. There haven't been many studies that have looked at retinal structures including blood vessels, the optic disc, the fovea, and lesions like microaneurysms, haemorrhages, and exudates. Here is a description of the main contributions made to the extraction of the normal and pathological features from fundus images.

M. M. Fraza et al 2012, provided a technique that made it possible to tell the exudates from the optic disc distinctly. Due to the identical intensity level of exudates on the optic disc and blood vessels, they are entirely eliminated before exudates are discovered. Therefore, morphological procedures like dilatation and degradation determine the presence and geographic distribution of exudates. In this segmented image, the exudates that indicate diabetic retinal degeneration are apparent. This method typically determines the illness's level of intensity as well as confirms its existence. The support vector machine (SVM) classifier is utilised to identify whether an individual is moderately or severely affected by this condition.

Exudates, the primary signs of diabetic retinopathy, can be extracted from retinal images using a computerised method developed by A. Alaimahal et al in 2013. The process consists mostly of two parts. Excluding the excision of the optical disc, morphological methods of image processing are used to first identify exudates that. The fuzzy logic technique is then used to categorise the discovered exudates. The fuzzy logic concept employs values using retinal picture information in the RGB coloring space for the fuzzy set. The types of discharges that have been discovered include normal, weak, and dense exudates. Without altering any mathematical parameters, this fully automated process can be used to analyze an archive of retina pictures.

Padmalal S ,et al 2014, emphasized the significance of creating automated methods for identifying irregularities in fundus imaging. The contrast of the fundus image was varied by the nonlinear curve of the hue saturated value (HSV) space with brightness values. Each red, green, & blue-bit image underwent gamma correction to draw attention to the brown regions. Then, the histograms of each red, blue, or blue-bit picture were enlarged. The candidates for bleeding were then identified. The brown patches were recognized as haemorrhages, veins, and their candidates using density analysis. They disqualified the strong contenders, such as blood vessels. Erroneous positives were eliminated via a 45-feature analysis. To evaluate the efficacy of the new method for detecting haemorrhages, they examined 125 images of the fundus, including 35 with bleeding and 90 normal images. The sensitivity for identifying anomalous instances.

Mahendran Gandhi et al 2013, suggested a way to extract characteristics from fundus images, such as blood vessels, microaneurysms, and exudates on the retina, utilizing morphological processing to determine the presence of abnormalities. These features are used to determine the degree of retinopathy caused by diabetes. After feature extraction, each feature's area is identified in order to classify the severity of the condition. Based on the results of an area computation of features, an approach is used to categorise the phases of diabetic retinopathy that are not proliferative as normal, mild, or severe. In the usual stage, there are no discharges or microaneurysms. What distinguishes the less severe stage of the illness are micro aneurysm. In the severe stage, both exudates & micro aneurysm are present.

Nimmy Thomas ,et al. 2014, devised a method for automatically determining the presence and severity of diabetes macular edoema (DME). In this region, Hard Exudates that (HE) are found, and the features are then eliminated. An adaptable neurofuzzy inference classification uses the obtained attributes as input to identify the images as either normal or abnormal. The parameters used for assessing the efficacy of ANFIS and ELM classifiers are sensitivity, specificity, and accuracy. These variables have the following values: 100%, 90%, and 96.49% for ANFIS and 94.28%, 100%, and 96.49% for ELM, respectively.

Chisako Muramatsu, et al 2011, developed a Differential Morphological Profile (DMP)-based automatic technique for exudate detection from colour fundus images. Exudates and the optic disc are prominent bright spots in the image obtained from the DMP. The real exudates are obtained in the following stage, which involves feature extraction based on the location of the optic disc, shape index, and area. Applying the suggested method to the DIARETDB1 database allows for the performance of the method to be assessed. The specificity, sensibility, and positive predictive accuracy (PPV) of the proposed approach were compared. The results show that the suggested approach performs better than other conventional approaches. It has been discovered that the suggested method, which has the highest sensitivity, appropriately identifies exudates. Specificity and Npv values are 99.99% and 98.23%, respectively.

Chandrashekar. M. Patil, et al. 2013, a mathematical morphology-based detection approach for microaneurysms and haemorrhage, was proposed. The matching filter and the morphological top-hat modification method are used to find red lesion candidates. Support Vector Machine (SVM) is used with 89 retinal images randomly picked from three databases, STARE, DIARETDBO, and DIARETDBI, to categorize red lesion areas and non-red lesion areas. With this method, sensitivity was 100% and specificity was 91%.

V. METHODOLOGY

Exudate feature extraction and classification are the two subsequent processes that most existing DR classification techniques follow. Image preprocessing is needed in the first stage to boost contrast and reduce noise. The possible candidate for exudates is then represented by segmenting and removing the white region of the image. Then, using feature analysis—which includes extraction of features and feature selection—DR is discovered. Using a classification method, these characteristics are separated into the various DR levels, such as typical and abnormal (mild, mild, severe). The general methods for fluid detection and DR categorization are summarised in Fig. 3.

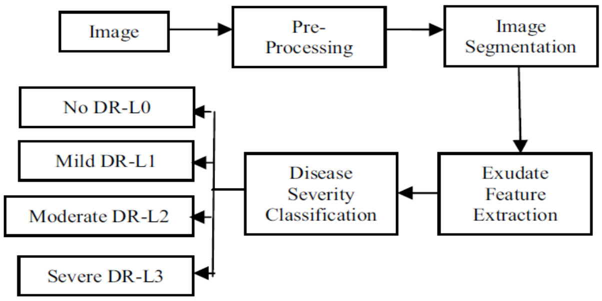

Fig. 3. The processes of DR Classification system

VI. TOOLS / PLATFORM TO BE USED

Learning is the practise of acquiring knowledge through study, as stated in its definition. In the specific instance of machine learning, a computer performs this learning process, making it possible to create computer programmes that automatically get better over time. The three applications of machine learning.

- **Data mining**: These systems are designed to use vast amounts of data that people cannot process on their own to make better decisions. Since it enables the generation of medical knowledge based on medical records, this offers, for instance, a particularly beneficial application in the field of medicine.

- **Software applications**: As absurd as it may seem, humans cannot programme everything in the world. However, these frontiers can be expanded with the help of machine learning algorithms. In the case of this project, Automatic Number Generation, for example, these kinds of approaches are currently being successfully implemented in sectors like autonomous driving, speech recognition, picture recognition.
- **Self-customizing programmers**: Even though most individuals might not be aware of it, practically everyone often interacts with this last specialty. In actuality, it is this type of technology that underlies the news feeds that consumers typically receive based on their individual interests when they browse the Internet.

By using an assortment of marked training examples, the algorithms have the ability to create broad target functions this, when used on a brand-new dataset which wasn't used before, accurately forecast the expected outcome. This is how machine learning algorithms actually work. The samples with label training make up the training dataset, whereas fresh, unused data make up the testing dataset. A sufficient good and comprehensive training dataset is necessary in these types of applications because a poor train always produces poor outcomes.

The GUI window displays the final output, which is represented in the html page connected to the main system. There is a "Load Data" button on the output page. After clicking the "Like" button, a script that extracts values from the dataset is run.

Aside from the fundamentals that have just been described, there isn't much that Machine Learning algorithms have in common. In reality, an algorithm for machine learning can be created in an endless number of different ways. Consequently, choosing the best design requires a thorough review, which is typically done using a variety of data.

VII. FLOW DIAGRAM

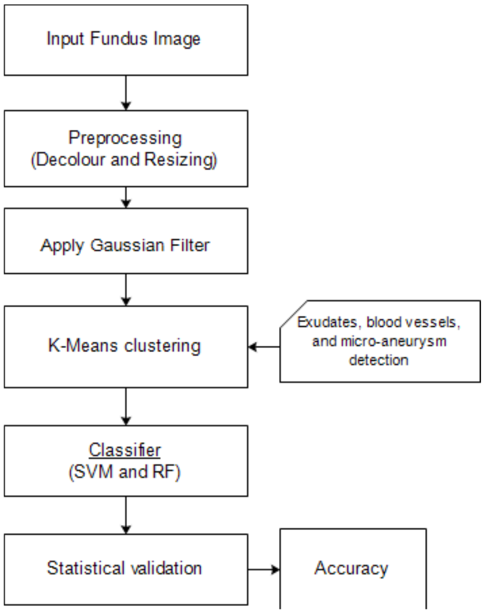

Fig. 4. Flow Chart

VIII. CONCLUSION

Recent studies have demonstrated positive results when retinopathy is diagnosed using machine learning, with improved generalization and accuracy than conventional methods. More research is required to solve challenges such as the lack of labelled data, choosing relevant features, and model adaption.

In this review, we examined ML concepts and discussed how they are applied to the diagnosis and prediction of retinopathy. The overwhelming majority of studies which have been reported in recent years have concentrated on developing prediction models utilizing supervised machine learning strategies and classification algorithms with the aim of properly forecasting illness outcomes. Reviewing their findings demonstrates that the utilization of multidimensional diverse information along with a variety of choice of features and classification approaches can be advantageous for the retinopathy domain.

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