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Classfication of Diabetic Retinopathy Using Deep Convolutional Neural Networks (Dcnns)

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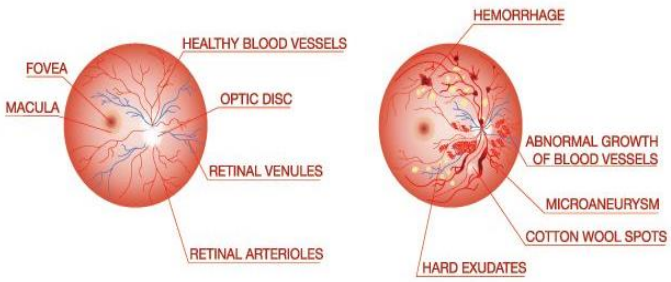
Abstract
Diabetic Retinopathy (DR) is a leading cause of vision impairment and blindness among individuals with diabetes. Early detection and accurate classification of DR stages are crucial for timely intervention and effective management. In recent years, Deep learning (DL) methods have emerged as powerful tools for image analysis, demonstrating remarkable success in various medical imaging applications. Large dataset, processing difficulty, complex training and computation time are the major drawbacks of existing work by using support vector machine (SVM) method. The objective of this proposed system gives proper results by using Deep Convolutional neural networks (DCNNs) techniques for the classification of Diabetic Retinopathy with high accuracy by using the feature analysis of blood vessels.

Keywords: Diabetic Retinopathy, Deep learning, Support Vector Machine, Deep Convolutional Neural Network.

1. Introduction

Diabetes can cause diabetic retinopathy (DR), an eye condition that can result in blindness. Accurate detection of DR and early diagnosis are critical to preventing blindness in diabetic patients. Convolutional neural networks (CNNs), one of the deep learning models, are primarily utilized in DR detection by classifying blood vessel pixels apart from the rest pixels. Using deep learning for diabetic retinopathy has several benefits. It can improve the accuracy and efficiency of diagnosing the condition by analyzing retinal images. Deep learning algorithms can detect subtle changes in the retina that may indicate the presence of diabetic retinopathy at an early stage. This early detection can lead to timely intervention and better management of the disease, potentially preventing vision loss. As glucose is transformed into energy, blood vessels fill with abnormally high blood sugar levels. When a patient has had diabetes for more than ten years, they acquire diabetic retinopathy, or DR [1]. High blood pressure is the cause of diabetic retinopathy (DR), which affects the retina and the retinal vascularization, potentially leading to blindness. In an effort to create automatic computer-aided decision support systems that assist in the diagnosis of DR, DL-based models and algorithms have also been developed to analyse retinal fundus pictures. Applications based on DL have been created and tested to process medical images and extract indications associated with drug resistance. Numerous computer-aided systems that integrate cutting-edge algorithms and telemedicine technologies have been tested in DR screening programmes and have been suggested for the early detection of DR onset.

Figure1 : Normal eye and eye effected with DR



2. Literature Review

In this section, we present a summary of published previous work related to Diabetic Retinopathy(DR) Classification using Deep Learning Methods for blood vessels monitoring in diabetic patients. The section also includes some existing works focused on big data and high accuracy classification to predict possible episodes of rises or falls in the blood vessels. Classification of Diabetic Retinopathy(DR) using Deep Learning methods.

Philip Marchenko [1] proposed a Deep learning approach to diabetic retinopathy detection, the methodology typically involves training a deep neural network on a large dataset of retinal images. The network learns to identify patterns and features in the images that are indicative of diabetic retinopathy. This trained network can then be used to classify new images and detect the presence of the condition.. The future work can extend this method with the calculation of SHAP for the whole ensemble, not only for a particular network, and with more accurate hyper parameter optimization.

The author in [2] G. Sivapriya. Present an automated diagnostic classification of diabetic retinopathy with microvascular structure of fundus images using deep learning method. The method involved is ReesEAD2Net is introduced in this work, which is inspired by the U-Net and Residual Net models. Deep learning models may memorize patterns specific to the training dataset, leading to reduced generalization performance on new and diverse data.

Ashish Bora [3] Created an validated two versions of a deep learning system to predict the development of diabetic retinopathy in patients called predicting the risk of developing diabetic retinopathy using deep learning. Interpretability challenges, and the risk of overfitting to specific populations. Additionally, model performance may be influenced by variations in imaging quality

Gazala Mushtaq [4] Worked on the Detection of diabetic retinopathy using deep learning methodology. The main objective of this work is build a stable and noise compatible system for detection of diabetic retinopathy. One of the main drawbacks in using deep learning for diabetic retinopathy detection is the challenge of interpretability. especially complex neural networks, are often considered "black boxes".

Saba Raoof [5] Mainly proposed the classification based on Data Preprocessing: Clean and preprocess the retinal images including resizing, Normalization. A diagnosis model for detection and classification of diabetic retinopathy using deep learning. One of the main drawbacks of a diagnosis model for detecting and classifying diabetic retinopathy using deep learning is its limited interpretability. Lack of interpretability can lead to reduced trust in the model's.

F. Bandello [6] Diabetic Retinopathy detection through deep learning the manual diagnosis process of DR retina fundus images by ophthalmologists is time, effort and cost-consuming and prone to misdiagnosis unlike computer aided diagnosis systems. The authors propose a Diabetic Retinopathy

detection through deep learning is promising. Advancements may include enhanced accuracy, real-time diagnosis personalised treatment plans, and integration with wearable devices for continues monitoring

Kalyani et al [7] Diabetic Retinopathy detection and classification using capsule networks, in these we use capsule network method it is used to detect the damage in the eye early. It is better way to detect diagnosis to avoid vision loss. The authors proposed for improved interpretability and robust feature extraction. Further developments may include optimizing network architectures, increasing dataset diversity, and exploring transfer learning techniques.

Anas Bilal [8] AI based automatic detection and classification of diabetic retinopathy using U-Net and deep learning it can presents a novel methodology for detecting diabetic retinopathy(DR) using retinal fundus images.Three publicly available datasets, Messidor-2,EiePACS-1, and DIARETDB0 are used. Overview of U-Net architecture, highlighting it's suitability for medical image segmentation tasks. The datasets used, performance metrics, and key findings of each study. Proposed a potential avenues for future research, including the development of more robust and generalized models, integration multi modal imaging data.

Hae Min Kang [9] Early detection of diabetic retinopathy based on deep learning and ultra wide field fundus we set an ROI for the DR detection to the ETDRS 7SF among the entire captured area of the retina in the UWF photography. It is also to align the image and reduce influence of obstacles such as eyelids and eyelashes. Integration with emerging technologies such as OCT and AI-driven decision support systems may enhance diagnostic accuracy.

Yannlecur [10] Automatic detection and classification of diabetic retinopathy using improved techniques this method gives the efficient results compared to the existing models early treatment for humans, enhanced accuracy and efficiency advancements may include the incorporation of multi modal imaging, such as OCT and angiography, to provide a comprehensive assessment. Additionally, exploring explainable AI methods to enhance transparency and trust in the decision-making process is important.

Wl Aloyubi[11] Diabetic Retinopathy fundus image classification and lesions localisation system using deep learning the review of existing deep learning-based systems for diabetic retinopathy classification and lesion localization the author proposed emerging trends in deep learning for diabetic retinopathy diagnosis potential improvements in classification and localisation accuracy integration with clinical work flows and telemedicine.

Alexandr Pak[12] proposed a Comparative Analysis of deep learning methods of detection of diabetic retinopathy is one of the significant causes of blindness. Since DR is a progressive process, medical experts suggest that patients with diabetics must be screened at least twice a year to diagnosis the signs of the disease promptly. With the current clinical diagnosis detection is mainly based on the fact that the ophthalmologist incorporating multimodal imaging data for improved detection and diagnosis. Investigating the use of AI techniques, such as reinforcement learning an generative adversarial networks for diabetic retinopathy detection.

Chava Harshitha[13] worked on Predicting the stages of diabetic retinopathy using deep learning this detection of an abnormality in a human eye by anther human naked eye is time taking, cost-consuming and it some times also leads to miss judgement, due to the subjective difference and considerations among the ophthalmologists for this predictive modals based on individual patient characteristics, including genetic predisposition, life style factors, and conorbibities, to optimise treatment strategies and out comes.

Feng li[14] Deep learning-based automatic detection for diabetic retinopathy and macular oedema in retinal fundus photographs integration multi modal imaging data for improved diagnostic accuracy. Development of real-time decision support system for point of care screening and telemedicine applications.

Sraddha Das[15] Deep learning architecture based on segmented fundus image feature for classification on of diabetic retinopathy for the extract discriminative features from the segmented regions of interest(ROIs) using methods of deep learning -based feature learning approaches for deep learning feature extraction, consider using convolutional neural network(CNNs) pretrained on large-scale in which data sets.

Mahalakshmi B et.al [16] explained about how to measure the Diabetes from a patient using IR sensor along with other parameters like temperature,SPO_2…

Mahalakshmi B et.al [17]discussed about which type of diabetes is the patient is suffering is classified by using machine learning algorithms with high accuracy.

Mahalakshmi B et.al [18]explained about the classification of diabetes of patient using one of the deep learning method of Convolutional Neural Network(CNN).

3. Existing Method

In this existing research work, the multi class Support Vector Machine learning technique with lesion and vessel analysis of retinopathy images are performed and the Deep learning technique is used to detect and classify the diabetic retinopathy images. Here the preprocessing of morphological process improves the image rate by performing laplacian concept of Gaussian filter with double factor of filtering approach and the pad array is constructed with the binary state of image. This detection stage executes a more thorough analysis of several classification feature results. Classifying various states of severity analysis, such as diabetic retinopathy (DR), age-related macular degeneration (AMD), and normal retina, constitutes a significant portion of the task. Proliferative diabetic retinopathy (PDR) and non-proliferative diabetic retinopathy (NPDR) are the two forms of diabetic retinopathy.

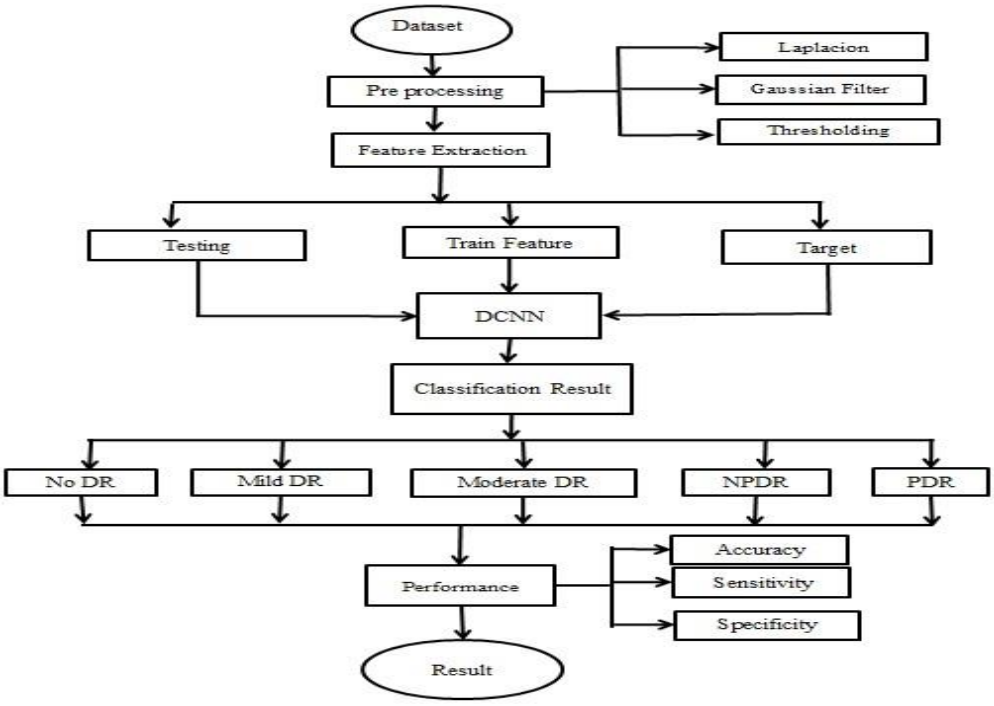
The main drawbacks of existing method is low accuracy and to overcome this drawback we are using Deep convolutional neural networks (DCNNs).

4. Proposed Method

The very high blood sugar levels cause significant damage to the blood vessels in the retina. Blood vessels in the eye begin to leak fluid causing the macula to swell or thicken, preventing blood from passing through. Sometimes, there is an abnormal growth of new blood vessels on the retina. All of the mentioned conditions can cause permanent loss of vision. Deep convolutional neural networks (DCNN) are the type most commonly used to identify patters in images and video. By using Deep convolutional neural networks method containing many hidden layers is the most important and for handle the large data.

The proposed work mainly focused on high accuracy and will give better results for classification, the other considerations on specificity and sensitivity also.

Figure 2: Flow Chart



5. Results and Discussions

Deep Convolutional neural networks (DCNNs) techniques for the classification of Diabetic Retinopathy with high accuracy by using the feature analysis of blood vessels is shown through various figures. Figure 3 explains the number of train and test images of datasets is shown through bar graph.

Figure 3 : Datasets of train and test images

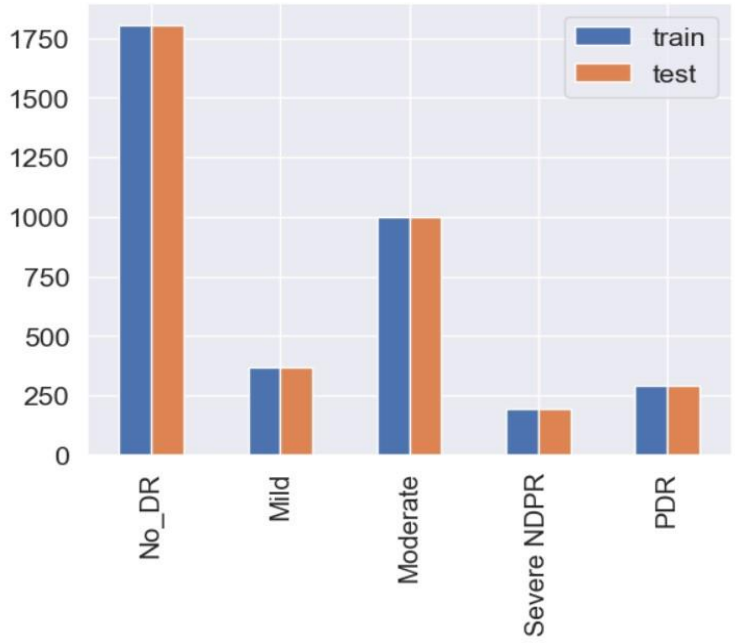


Figure4 shows the system performance values of precision,recall,f1-score,support,accuracy basing on confusion matrix given values as shown in figure5 .

Figure 4 : Values of Precision

	precision	recall	f1-score	support
0	0.89	0.95	0.92	361
1	0.42	0.31	0.36	74
2	0.71	0.80	0.75	200
3	0.56	0.13	0.21	39
4	1.00	1.00	1.00	58
accuracy			0.80	732
macro avg	0.72	0.64	0.65	732
weighted avg	0.78	0.80	0.79	732

Figure 5: Confusion Matrix

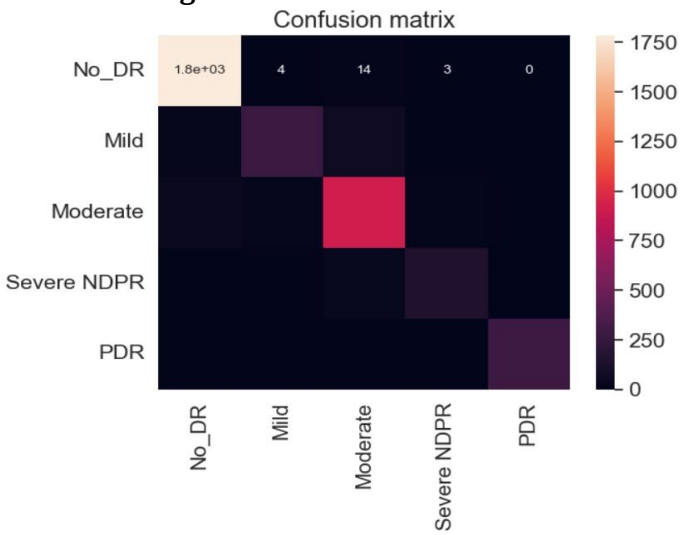


Figure 6 shows the one of the output given by the system when ever given one of the diabetic patient retina image and system given out put patient is suffered from mild DR.

Figure 6: Output

6. Conclusion

The study explore the strategy to give proper result for classification in diabetic retinopathy by using DCNN algorithm which contains multiple hidden layers to give high accuracy. In future the work may be extended by using Artifical Intelligence(AI) algorithms for inputs as large datasets.

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