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Automated Diabetic Retinopathy Detection Using CNN Algorithm

P. Praveen Kumar[1], T. Kiriti Sri Sai[2], Sk. Mohammed Noor[3], N. Harish[4], K. Thrilochana Devi[5]
[1,2,3,4]*B.Tech. Students, Department of IT, Vasireddy Venkatadri Institute of Technology, Guntur*
[5]*Assistant Professor, Department of IT, Vasireddy Venkatadri Institute of Technology, Guntur*

***Abstract*— Diabetic Retinopathy (DR) is quite common, among a segment of the population who have diabetes. Diabetic retinopathy is a condition that damages the tissues of diabetic individuals and in severe cases, it leads to permanent blindness if not diagnosed properly for a long time. If diagnosed early, consequences can be minimized. In previous work, the detection of DR is done by Machine learning and image processing techniques. In our proposed research work we employ a pre-trained machine learning algorithm based on Convolutional Neural Networks (CNN) to expedite the diagnosis process by analyzing images Based on disease severity, captured images are classified into five categories based on disease severity. As CNN is a fully connected neural network a Deep Learning algorithm, it needs little pre-processing than other classification methods. In our work, we use a recently developed and efficient model named EfficientNet-B5 Efficient net B5 in conjunction with threshold is implemented to increase the performance of our work. The effectiveness of our method in classifying DR cases. Our work has the potential to reduce the likelihood of blindness, for individuals affected by DR.**

Keywords. Deep Learning, Convolutional Neural Networks (CNN) Diabetic Retinopathy, Efficient Net B5 Fundus Photography.

I. INTRODUCTION

Diabetic Retinopathy is a consequence of excessive blood glucose, also known as diabetes, that affects the eyes. In severe cases, it might result in total blindness as well as vision loss. Diabetic retinopathy's initial symptoms include blurred vision, darker patches in the field of vision, eye floaters, and trouble seeing colors. It is crucial to identify diabetic retinopathy correctly in its early stages to avoid total blindness.

Roughly one-third of the 285 million persons with diabetes mellitus estimated to exist worldwide exhibit symptoms of diabetic retinopathy.

By 2030, there will be 191.0 million diabetic retinopathy sufferers worldwide, up from 126.6 million in 2010. This Diabetic retinopathy can be detected or classified by automation using the extended family of machine learning called deep learning. strategies. It is compatible with layer-based modeling. Among them is the Convolutional Neural Network (CNN). In the domain, CNN is essential to deep learning since it may be used in recognition, classification, segmentation, image processing, and so forth. Since CNN is a neural network with complete connectivity, it needs less pre-processing than other techniques for classification. Within our work, we employ a newly created, effective methodology called Net Efficient-B5. This is an approach to scaling that can grow. CNN in a more organized way. We employ this framework because it provides up to ten times greater precision than an additional Conv-Net. It plays and is a pre-trained model. A remarkable part of this is it is necessary to diagnose these patients very soon to mitigate the severe impact of Diabetic Retinopathy. The signs of DR can be listed as including but not limited to the existence of microaneurysms, hard exudates, vitreous hemorrhages, and retinal detachments. retina images with different DR levels such as (a) normal, (b) mild, (c) moderate, (d) severe, and (e) proliferative. As shown in Figure 1(a), there is no abnormal lesions in the normal retina

II. LITERATURE SURVEY

According to recent studies, DR can be diagnosed accurately and consistently in the early stages by applying automatic screening systems.
There are several methods and different algorithms to classify Diabetic retinopathy

1. [ANAS BILAL,2021] proposed an ML method that analyzed retinal images of the eye to identify five distinct tissue types. Following

feature extraction using the KNN and SVM methods. The preprocessing step enhances abnormality presence as well as segmentation; the extraction step acquires merely relevant features; and the classification step uses classifiers such as support vector machine (SVM), K-nearest neighbor (KNN), and binary trees (BT).

2. [Butt et al,2022] described a system for diabetic retinopathy classification literature related to DR detection is mostly divided into traditional and modern machine learning and image processing techniques. provides significant performance improvement in DR detection for fundus images.
3. [Farrikh Alzami, 2019] described a system for diabetic retinopathy grade classification based on fractal analysis and random forest using the MESSIDOR dataset. Their system segmented the images and then computed the fractal dimensions as features. They failed to distinguish mild diabetic retinopathy from severe diabetic retinopathy.
4. [V. Agarwal,2020] proposed Architectural details of all efficient-net models.

III. METHODOLOGY

1. Gathering Data:
Gather a varied and representative sample of retinal pictures, containing examples of both normal and diabetic retinopathy. Ascertain accurate picture labeling (e.g., illness severity levels) to facilitate supervised learning.
2. Preprocessing Data:
Images should be resized to a standard format. Pixel values should be normalized to a common scale, such as [0, 1]. To make the model more resilient, add more data (such as zooms, flips, and rotations). If there is a class imbalance, address it with methods like data augmentation or oversampling.
3. Splitting Data:
Separate the dataset into sets for testing, validation, and training. Make sure that the distribution of classes in each set is representative.
4. Architectural Model:
Create a CNN architecture that is appropriate for categorizing images. Custom designs or variants on the Efficient-net concept are examples of common architectures. To match the preprocessed image, adjust the input size.

Features to be Extracted:
- exudates (appear as yellow or white spots on retinal images),
- hemorrhages (that appear as small, dark spots or blotches on retinal images) and
- microaneurysms (look like small red dots on retinal images).

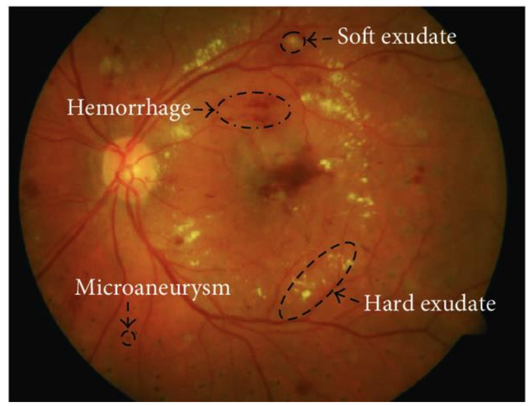

Fig.1: Features On the retinal image

5. Representation: In this the classified retinal images are represented in 2 different forms firstly bar graph shows how much percentage of which class is present in the dataset and the bar graph shows the severity of the image.

IV. RESULT

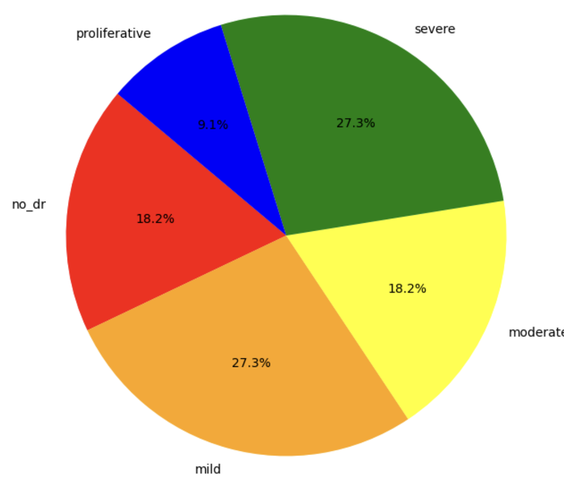

Fig1: Pie Chart-Severity Distribution of Retinal Images in Dataset

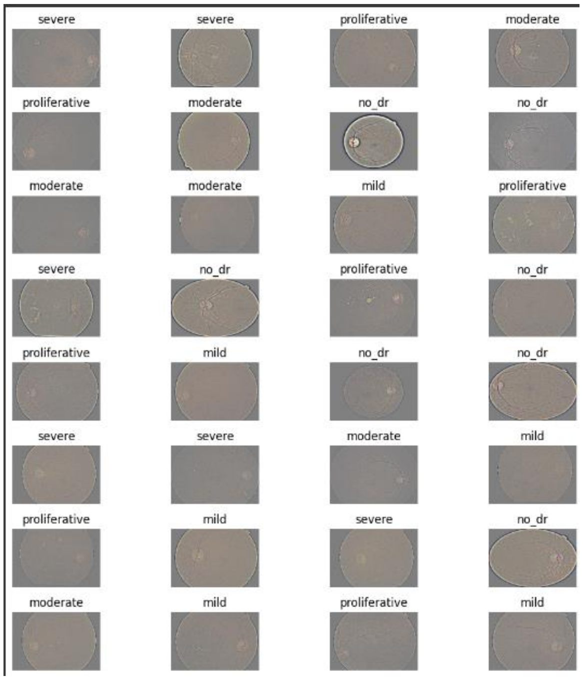

Fig.3: Retinal images of Dataset classified into respective classes

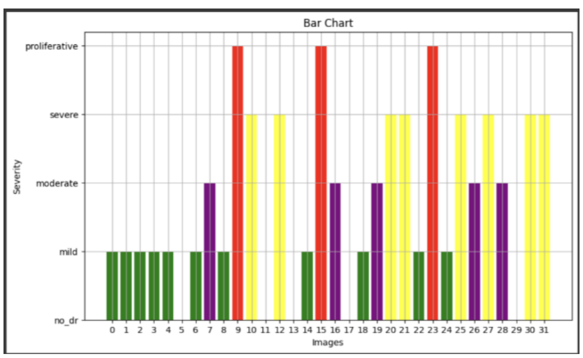

Fig4: Bar Graph: The graphical representation of the severity of the retinal images

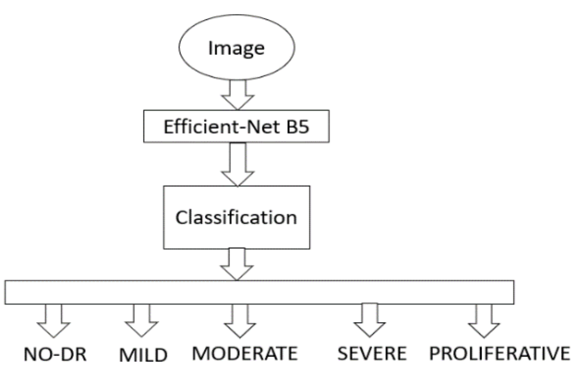

Fig5: System Architecture of Diabetic Retinopathy System (DRS)

PREDICTION:

In this phase, we are going to take any external image as an input and we train the image with the images in the dataset.

If we want to predict the severity of the retinal image this process is done by saving the trained model and loading it now this image is compared to the retinal images in the loaded model and the predicted severity of the image is by providing it the label of which class it belongs to with the input image that is provided for the prediction as shown in the below figure:

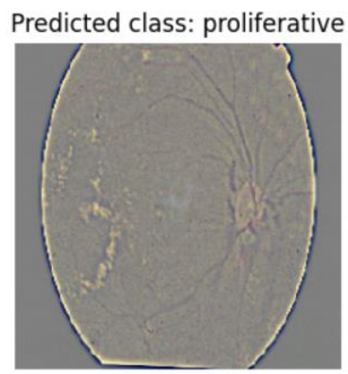

Fig 6: Output image with its severity type

V. CONCLUSION AND FUTURE WORK

Diabetes-related complications such as diabetic retinopathy are a serious risk to vision. Diabetes is an illness that should be taken very seriously due to its high prevalence. The condition is caused by the blood vessels in the retina, which is a sensitive tissue that is involved in vision. Diabetic retinopathy may not show any symptoms at all in its early and intermediate phases. But when it reaches a more advanced stage, it can result in permanent blindness. Early identification is essential to preventing severe retinal damage, and numerous current projects aim to accomplish this goal.

CONCLUSION:

Pre-trained models have become a viable method for detecting diabetic retinopathy in current research, which improves the performance of convolutional neural networks (CNNs). We made use of the pre-trained model EfficientNet-B5 in this investigation. Our use of EfficientNet-B5 produced excellent results, with an accuracy of about 94%, demonstrating the effectiveness of our prediction technique.

In future work, investigation can be done on more sophisticated pre-trained models, like EfficientNet-B6 and B7, and want to apply our methodology to other datasets with different sizes and compositions. Hence extension will make it easier to comprehend in detail how dataset volume and model performance are related. In addition, we plan to evaluate the generalizability of our method by utilizing it to forecast various ocular disorders such as glaucoma, macular degeneration, and others. This comprehensive study has the potential to improve our knowledge of retinal disorders and help develop preventative healthcare plans, which will ultimately lead to a healthier future.

VI. REFERENCES

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