Diabetic Retinopathy Detection System Using Machine Learning

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***Abstract*—Diabetes is a disease that affect the body's ability to produce or use insulin, a hormone that regulates blood sugar or glucose levels. Diabetic Retinopathy (DR) is an eye disease in humans with diabetes which may harm the retina of the eye and may cause total visual impairment. Therefore, it is critical to detect diabetic retinopathy in the early phase to avoid blindness in humans. Our aim is to detect the presence of diabetic retinopathy by applying Machine learning algorithms. Hence, we try and summarize the various models and techniques used along with methodologies used by them and analyze the accuracies and results. It will give us exactness of which algorithm will be appropriate and more accurate for prediction. Machine learning consists of a number of stages to detect retinopathy in the images that includes converting image to suitable input format, various preprocessing techniques. It also includes training a model with a training set and validating with a different testing set. Method proposed in this project is Resnet 152.Berfore applying alorithum retinal images must be Preprocessing, and Feature Extraction. First, the images are preprocessed. They are converted. Proper resizing of image is also done. As the images are heterogeneous, they compressed into a suitable size and format. Data set used for this project is taken from Kaggle. The main objective of this work is to build a stable and noise compatible system for detection of diabetic retinopathy.**

***Index Terms*—Machine learning, Diabetic Retinopathy, Resnet-152**

I. INTRODUCTION

This project presented the development of an automated system for diabetic retinopathy detection in color retina images; through the implementation of Deep learning techniques Diabetic retinopathy is indeed one of the most common and serious complications of diabetes. It results from damage to the blood vessels in the retina due to prolonged high blood sugar levels. Traditionally, detecting DR is a time-consuming and manual process, which requires an ophthalmologist or trained clinician to examine and evaluate digital color photographs of the retina, to identify the presence of vascular abnormalities caused by the DR. There are different stages of DR no DR, mild DR, moderate DR, severe DR and proliferative DR. People with DR whose eye sight is at risk can be treated with laser, to prevent visual blindness. But currently there is no treatment that can restore the vision that has already been lost therefore early detection of DR is important to stop further damage of eye and to save patient life.

1. The proposed methodology is use of deep learning technique to detect diabetic disease using Retinal images of an eye and to introduce the effect of as a diagnosis imaging modal which are helpful for ophthalmologists to do the clinical diagnosis. In the proposed Project work to design and implement a system that can be provide eye diabetic disease detection using Retinal image, the system carried out various features extraction using image segmentation and use CNN Deep learning classification algorithm to detect the stage of DR. The Interface will be in the form of application software where user can insert retina image and then it will be pre-processed and feature extracted and then these will compare with training dataset and then analysed the actual result.
2. The largest publicly available dataset of retina images Kaggle dataset (APTOS) is used to train and evaluate our model and then image processing is performed and Gaussian filter is applied to convolve with the image. It helps in smoothening the image to reduce the effects of obvious noise on the edge detector. In this project we used CNN Deep learning classification algorithm to detect the the stage of DR. Resnet 152 Convolution Neural Network (CNN) architecture used for feature extraction and

prediction of the class of DR. It has the ability to train to understand the complexity of the image more efficiently. The main objective of this work is to build a stable and noise and high accuracy compatible system for detection of diabetic retinopathy.

II. LITERATURE SURVEY

Reference No:1
Title: Diabetic Retinopathy Detection Using Deep Learning.
Publication: IEEE Access, vol. 12, pp. 84785-84802, 2024, doi: 10.1109/AC-
CESS.2024.3415617.
Author: Suwarna Gothane, K. Srujan Raju
Summary: Diabetes sickness upsurges the quantity of glucose in the blood trig-
gered by a deficiency of insulin. Diabetes affects retina, heart, nerves and kidney.
One important complication is Diabetic Retinopathy. The mechanized methods
for Diabetic Retinopathy recognition are flexible for cost and time reduction and
aremore competent over manual analysis. Deep Learning technique performs com-
puter aided medical diagnosis.

Reference No:2
Title: Diabetic retinopathy detection through deep learning techniques
Publication: 2021 Third International Conference on Intelligent Communication
Technologies and Virtual Mobile Networks (ICICV).
Author: Wejdan L. Alyoubi *, Wafaa M. Shalash, Maysoon F. Abulkhair.
Summary: Diabetic Retinopathy (DR) is a common complication of diabetes
mellitus, which causes lesions on the retina that effect vision. If it is not detected
early, it can lead to blindness. Unfortunately, DR is not a reversible process, and
treatment only sustains vision. DR early detection and treatment can significantly
reduce the risk of vision loss. The manual diagnosis process of DR retina fundus
images by ophthalmologists is time-, effort-, and cost-consuming and prone to mis-
diagnosis unlike computer-aided diagnosis systems.

Reference No:3
Title: Diabetic Retinopathy Detection Using Deep Learning.
Publication: Received August 30, 2019, accepted October 1, 2019, date of publi-
cation October 11, 2019, date of current version October 31, 2019.
Author:Suwarna Gothane, K. Srujan Raju, Nuthanakanti Bhaskar, and G. Divya.
Summary: Diabetes sickness upsurges the quantity of glucose in the blood trig-
gered by a deficiency of insulin. Diabetes affects retina, heart, nerves and kidney.
One important complication is Diabetic Retinopathy. The mechanized methods for
Diabetic Retinopathy recognition are flexible for cost and time reduction and are
more competent over manual analysis. Deep Learning technique performs computer
aided medical diagnosis. This paper is an attempt toward finding an automatic so-
lution for Diabetic Retinopathy disease in initial stage.

III. PROBLEM STATEMENT

Diabetic retinopathy (DR) is one of the most common causes of vision loss among diabetic patients. It results from long-term damage to the blood vessels in the retina due to elevated blood glucose levels.

If left undiagnosed and untreated, DR can lead to severe vision impairment or even blindness. Early detection and timely intervention can significantly reduce the risk of blindness and prevent further complications.

Given that diabetic retinopathy typically progresses without early symptoms, it is crucial to regularly monitor diabetic patients for signs of the disease. Current methods of diagnosing DR involve manual inspection of retinal images by trained ophthalmologists or specialists, a process that can be time-consuming, subjective, and prone to human error.

IV. METHODOLOGY

4.1 Dataset

The Asia Pacific Tele-Ophthalmology Society 2019 Blindness Detection (APTOS 2019 BD) dataset contains 3662 retinal Image samples collected from many participants of rural India. The, Aravind Eye

Hospital, India, organized the dataset. The fundus photographs were collected in varying conditions and environments over a long period. Later, a group of Expert doctors reviewed and labeled the gathered retinal image samples following the principle of the International Clinical Diabetic Retinopathy Disease Severity Scale (ICDRSS). As per the scaling system, the APTOS 2019 Blindness Detection Dataset are divided into five Classes: no Diabetic Retinopathy (DR), mild DR, moderate DR, severe DR, and proliferative DR.

This dataset has 3662 images and consists of 1805 images diagnosed as non-diabetic (labeled as 0) retinopathy and 1857 images diagnosed as diabetic retinopathy, as shown in Figure 4.5shows the distribution of examples in the four classes using a severity range from 1 to 4 with the following interpretation: 1: Mild, 2: Moderate, 3: Severe, 4: Proliferative DR.

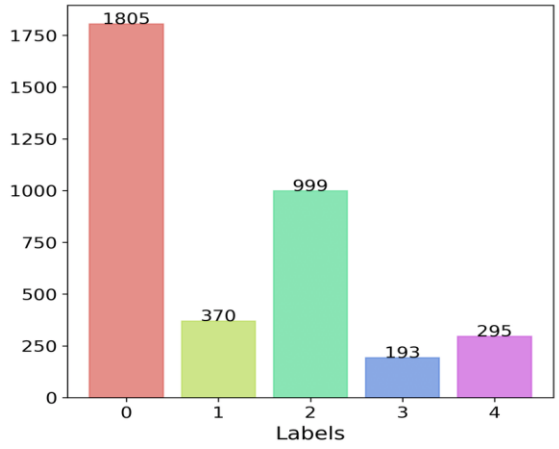
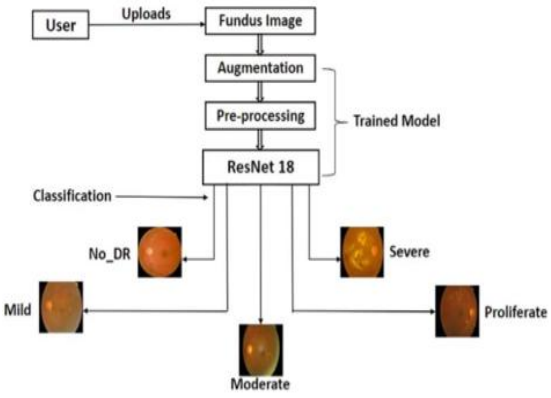


Fig 5.1 Distribution of APTOS Dataset

4.2 System Architecture:



3.3 Algorithm: Diabetic Retinopathy Detection Using ResNet

Step 1: Collect retinal fundus images from the dataset (e.g., APTOS 2019).

Step 2: Apply data augmentation techniques such as rotation, flipping, and brightness adjustment to increase dataset diversity.

Step 3: Perform image preprocessing, including noise removal, contrast enhancement, normalization, and resizing images to 224 × 224 pixels.

Step 4: Input the preprocessed images into a ResNet-18 convolutional neural network for feature extraction.

Step 5: Extract deep features through convolutional layers and residual blocks to capture retinal patterns related to diabetic retinopathy.

Step 6: Pass the extracted feature vector through a fully connected layer for classification.

Step 7: Apply the Softmax activation function to compute probabilities for each diabetic retinopathy class.

Step 8: Select the class with the highest probability as the final prediction among the five DR stages: No DR, Mild, Moderate, Severe, and Proliferative.

Step 9: Display the predicted diabetic retinopathy stage as the output.

V. RESULTS AND DISCUSSION

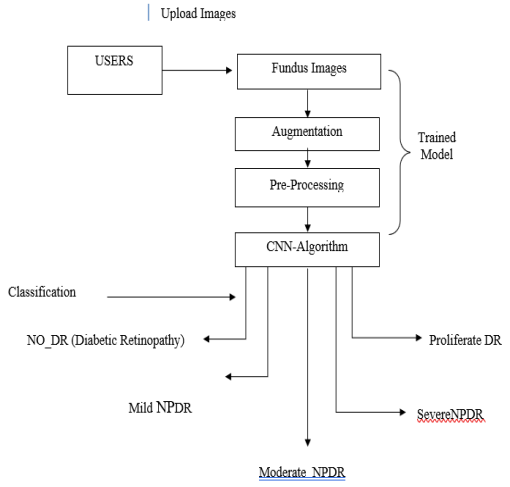
Diabetes is a significant health concern globally. According to various surveys, a patient having diabetes has around 30% chances to get Diabetic Retinopathy (DR). Diabetic retinopathy has Five stages from mild to severe and then PDR (Proliferative Diabetic Retinopathy). In the last stages of the diseases, it leads to floaters, blurred vision and finally can lead to blindness if it is not detected in the early stages. Manual diagnosis of these images requires highly trained experts and is time-consuming and difficult. Computer vision-based techniques for automatic detection of DR and its different stages have been proposed in this Project. Our main aim to classify all the stages of DR, especially the early stages.We proposed a CNN ensemble-based Transfer learning model which is pretrained on millions of images. Resnet 152 is pre-trained model used to detect and classify the DR's different stages in color fundus images. We used the largest publicly available dataset of Retinal images (APTOS dataset) to train and

evaluate our model.In this project we get accuracy of 87% for APTOS dataset.

VI. PROPOSED SYSTEM

1. In the traditional healthcare system, detection of Diabetic Retinopathy (DR) was performed manually by ophthalmologists through direct examination of fundus images or retinal scans. The process involved visual inspection of the retina to identify signs such as micro aneurysms, hemorrhages, and exudates, which indicate the severity of the disease.
2. This manual diagnostic approach was time-consuming, subjective, and prone to human error, especially when screening a large number of patients. The accuracy of diagnosis largely depended on the experience and expertise of the medical professional. In rural or underdeveloped areas, limited access to qualified ophthalmologists often delayed diagnosis, leading to late detection and possible vision loss.
3. Moreover, traditional image analysis methods relied on handcrafted feature extraction techniques, such as texture analysis, edge detection, and color histogram-based segmentation. These methods required manual preprocessing and domain-specific tuning, which often resulted in inconsistent and unreliable performance across different image qualities, lighting conditions, and patient demographics.

Proposed Diagram:



Project Result:

Figure .1: Registration

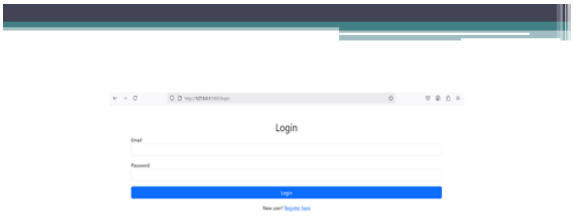


Figure2: Login

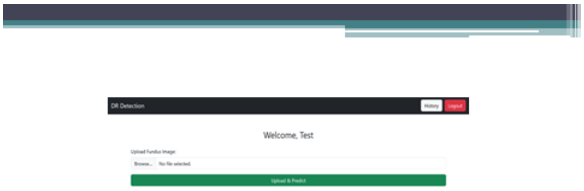
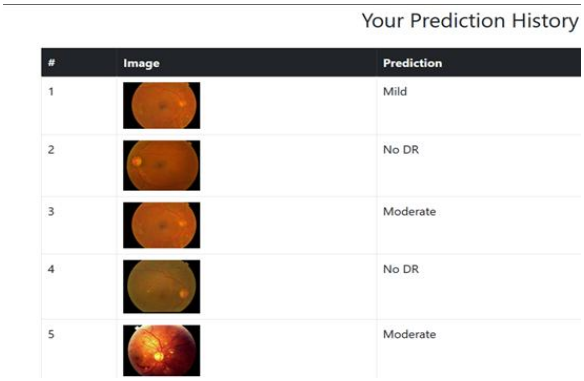


Figure3: DR Detection



Comparative Table:
Comparative Performance of Diabetic Detection System

Class	Precision	Recall	F1-Score
No DR	0.92	0.94	0.93
Mild	0.85	0.82	0.83
Moderate	0.88	0.87	0.87
Severe	0.84	0.81	0.82
Proliferative DR	0.90	0.88	0.89

VII. CONCLUSION

- Diabetes is a significant health concern globally. According to various surveys, a patient having diabetes has around 30% chances to get Diabetic Retinopathy (DR). Diabetic retinopathy has Five stages from mild to severe and then PDR (Proliferative Diabetic Retinopathy). In the last stages of the diseases, it leads to floaters, blurred vision and finally can lead to blindness if it is not detected in the early stages. Manual diagnosis of these images requires highly trained experts and is time-consuming and difficult. Computer vision-based techniques for automatic detection of DR and its different stages have been proposed in this Project.

REFERENCES

[1] Y. Abushawish, S. Modak, E. Abdel-Raheem, S. A. Mahmoud, and A. J. Hussain, "Deep Learning in Automatic Diabetic Retinopathy Detection and Grading Systems: A Comprehensive Survey and Comparison of Methods," *IEEE Access*, vol. 12, pp. 84785–84802, 2024, doi: 10.1109/ACCESS.2024.3415617.

[2] S. Zhu, C. Xiong, Q. Zhong, and Y. Yao, "Diabetic Retinopathy Classification with Deep Learning via Fundus Images: A Short Survey," *IEEE Access*, vol. 12, pp. 20540–20558, 2024, doi: 10.1109/ACCESS.2024.3361944.

[3] Y. Nikhila and G. Pradeepini, "Diabetic Retinopathy Detection Using VGG-16 Deep Learning Architecture," *Journal of Electrical Systems*, vol. 20, no. 7S, pp. 3620–3627, 2024.

[4] W. Nazih, A. O. Aseeri, O. Y. Atallah, and S. El-Sappagh, "Vision Transformer Model for Predicting the Severity of Diabetic Retinopathy in Fundus Photography-Based Retina Images," *IEEE Access*, vol. 11, pp. 117546–117561, 2023, doi: 10.1109/ACCESS.2023.3326528.

[5] S. Gothane, K. S. Raju, N. Bhaskar, and G. Divya, "Diabetic Retinopathy Detection Using Deep Learning," in *Data Engineering and Intelligent Computing*, Singapore: Springer, 2022, pp. 387–393, doi: 10.1007/978-981-19-1559-8_39.

[6] M. Z. Atwany, A. H. Sahyoun, and M. Yaqub, "Deep Learning Techniques for Diabetic Retinopathy Classification: A Survey," *IEEE Access*, vol. 10, pp. 28642–28655, 2022, doi: 10.1109/ACCESS.2022.3157632.

[7] S. Majumder and N. Kehtarnavaz, "Multitasking Deep Learning Model for Detection of Five Stages of Diabetic Retinopathy," *IEEE Access*, vol. 9, pp. 123220–123230, 2021, doi: 10.1109/ACCESS.2021.3109240.

[8] L. Qiao, Y. Zhu, and H. Zhou, "Diabetic Retinopathy Detection Using Prognosis of Microaneurysm and Early Diagnosis System for Non-Proliferative Diabetic Retinopathy Based on Deep Learning Algorithms," *IEEE Access*, vol. 8, pp. 104292–104302, 2020, doi: 10.1109/ACCESS.2020.2993937.

[9] S. Kajan, J. Goga, K. Lacko, and J. Pavlovičová, "Detection of Diabetic Retinopathy Using Pretrained Deep Neural Networks," in *Proc. 2020 Cybernetics & Informatics (K&I)*, Velké Karlovice, Czech Republic, 2020, pp. 1–6.