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Detection of Exudates of Diabetic Retinopathy using Deep Learning Algorithms

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Abstract: A major cause of human vision loss worldwide is Diabetic Retinopathy (DR). The disease requires early screening for slowing down the progress. However, in low-resource settings where few ophthalmologists are available to care for all patients with diabetes, the clinical diagnosis of DR will be a considerable challenge. The recent studies on the detection of DR by using one of the efficient algorithms of deep learning, which is Convolutional Neural Networks (CNN), which highly used to detect DR features from retinal images. CNNs approach to DR detection saves time and expense, and is more efficient and accurate than manual diagnostics. Therefore, CNN is essential and beneficial for DR detection. The suggested approach employs the CNN machine learning technique to diagnose diabetic eye illness by analyzing thermal pictures. These photos are pre-processed by transforming them from RGB to GRAY, which is then used to extract the relevant characteristics. The Convolutional Neural Network is used to identify 5 stages of diabetic retinopathy in order to detect it.

Keywords: Diabetic retinopathy; retinal images; detection; convolutional neural networks, image processing

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I. INTRODUCTION

Diabetic retinopathy, a kind of diabetic eye disease, is a significant problem that may affect diabetic patients. If Diabetic Retinopathy is not recognised or treated in a timely manner, it may result in serious vision loss or perhaps blindness. Diabetic Retinopathy is caused by alterations in the blood vessels of the retina, which is a light-sensitive tissue located at the rear end of the eye. The strength of your retina determines how clear your eyesight is. The patient's blood and sugar levels, as well as blood pressure changes, such as high blood pressure and hypertension, can cause retinal damage and DR, resulting in the patient's blindness. According to the latest survey conducted at the Central Council of Health and Family Welfare conference in October 2019, Diabetic Retinopathy affects around 17 percent of the Indian population. The main emphasis of this article is on utilising imaging to detect diabetic retinopathy. An method called as Convolutional Neural Network will be employed for this system. CNN is a deep learning branch that has a number of applications in image processing, including medical imaging.

Deep learning has recently been enhanced for the purpose of computer vision in image diagnostics and classification, and is a key device that has been used to automate a task in people's lives [9]. Convolution Neural Networks (CNN) have been systematically built to identify objects, segment them, and classify them [10]. CNNs are a kind of artificial neural network that has been shown to be very good at picture classification and recognition [12]. CNN has been used to successfully analyse visual information to identify people and objects [14]. Additionally, CNN has been successfully employed to solve a variety of medical picture problems [15]. CNN is one of the most essential approaches for automating retinal image analysis. The CNNs is utilised to categorised retinal injury to an adequate degree and also to extract aspects of retinal damage. Many investigations are centred on the abnormalities typically termed as (Exudates) or light lesions . Another technique to examine whole retinal pictures is designated then as an acceptable degree of diabetic retinopathy. They employ several picture pre-processing methods to extract numerous significant characteristics, which are then sorted into distinct groups. Furthermore, CNNs may be used to identify the five degrees of retinal damage DR. Finally, for performance assessment of the presented models, employ specificity, accuracy, sensitivity, (ROC) Receiver Operating Characteristic, and (AUC) Area

Under Curve. Additionally, it may get the greatest publicly accessible picture datasets to train its models. This research presented a method for detecting DR using CNN, as well as the relevance of this algorithm and how to effectively apply it for DR detection.

II LITERATURE SURVEY

According to [1] a novel adapter and enhanced self-attention based CNN framework named AES-Net for effective classification of glaucoma stages. In particular, we propose a spatial adapter module on top of the backbone network for learning better feature representations and an enhanced self-attention module (ESAM) to capture global feature correlations among the relevant channels and spatial positions. The ESAM assists in capturing stage-specific and detailed-lesion features from the fundus images.

In [2] a lightweight multi-scale CNN architecture called as CDAM-Net for effective glaucoma identification from retinal fundus images. Additionally, we introduce an attention module called channel shuffle dual attention (CSDA), comprising of a channel attention block, a spatial attention block and a channel shuffle unit, to focus on important regions in the fundus images, thereby extracting class-specific features. The CDAM-Netmainly consists of multi-scale feature representation (MFR) blocks that enable the extraction of multi-scale features from fundus images. Each MFR block is followed by a CSDA module, which further helps enrich the feature representation.

Infrared Imaging for Human Thermography and Breast Tumor Classification using Thermal Images [3]. The significance of Infrared Thermography (IRT) and the role of machine learning in thermal medical image analysis for human health monitoring and various disease diagnosis in preliminary stages. The first part of the proposed study provides comprehensive information about the application of IRT in the diagnosis of various diseasessuch as skin and breast cancer detection in preliminary stages, dry eye syndromes, and ocular issues, liver disease, diabetes diagnosis and last but not least the novel COVID-19 virus. Whereas in the second phase we have proposed an autonomous breast tumor classification system using thermal breast images by employing state of the art Convolution Neural Network (CNN).

Detection of Diabetic Eye Disease from Retinal Images Using a Deep Learning Based CenterNet Model [4]. The manual localization of DR and DME lesions requires experienced human experts to locate finer points of interest from colored fundus images, and classify them into appropriate groups through a grading system. To cope with the challenges of a manual detection system, a robust automated technique based on a custom CenterNet model and a DenseNet-100 feature extractor is introduced in the proposed work. We evaluated our approach on two benchmark datasets, namely, APTOS-2019 and IDRiD, and achieved accuracies of good respectively.

Machine Learning-based Diabetic Retinopathy Early Detection and Classification Systems- A Survey [5]. The performance of various machine learning algorithms-based DR detection and classification systems. These systems are trained and tested using massive amounts of retina fundus and thermal images from various publicly available datasets. These systems proved their success in tracking down the warning signs and identifying the DR severity level. The reviewed systems' results indicate that ResNet50 deep convolutional neural network was the most effective algorithm for performance metrics. The Resnet50 contains a set of feature extraction kernels that can analyze retina images to extract wealth information.

Svm Based Method For Diabetic Eye Disease Detection [6]. a non-invasive procedure has been presented to guage the presence of diabetic diseases within the eye. The classification of diabetic diseased and normal eye IR images is completed through Support Vector Machine classifier using various combination of texture and statistical features The simulation results indicate that the classifier in the detection of diabetic diseased eye performed in the accepted level and provide accuracy, sensitivity, specificity classifier.

Facial Paralysis Detection in Infrared Thermal Images Using Asymmetry Analysis of Temperature and Texture Features [7]. a quantitative thermal asymmetry analysis method for early diagnosis of facial paralysis in infrared thermal images. First, to improve the reliability of thermal image analysis, the facial regions of interest (ROIs) were segmented using corner and edge detection. A new temperature feature was then defined using the maximum and minimum temperature, and it was combined with the texture feature to represent temperature distribution of facial ROIs. Finally, Minkowski distance was used to measure feature symmetry of bilateral ROIs. The feature symmetry vectors were input into support vector machine to evaluate the degree of facial thermal symmetry. The results showed that there were significant differences in thermal symmetry between patients with facial paralysis and healthy people.

Automatic Detection of Diabetic Eye Disease Through Deep Learning Using Fundus Images: A Survey [8]. a systematic survey of automated approaches to diabetic eye disease detection from several aspects, namely: i) available datasets, ii) image pre-processing techniques, iii) deep learning models and iv) performance evaluation metrics. The survey provides a comprehensive synopsis of diabetic eye disease detection approaches, including state of the art field approaches, which aim to provide valuable insight into research communities, healthcare professionals and patients with diabetes.

Pre-diagnosis of Diabetic Retinopathy using Blob Detection [9].an effective feature extraction technique based on blob detection followed by classification of different stages of diabetic retinopathy using machine learning technique. This feature extraction technique could help automatic characterization of retina images for diabetic retinopathy with an accuracy of 83 per cent with the most efficient machine learning classification algorithm, which would help specialists to handily recognize the patient’s condition in a progressively precise manner.

Automatic Detection of Diabetic Retinopathy: A Review on Datasets, Methods and Evaluation Metrics [10]. The system, analysis and explanation of retinal fundus images need ophthalmologists, which is a time-consuming and very expensive task, but in the automated system, artificial intelligence is used to perform an imperative role in the area of ophthalmology and specifically in the early detection of diabetic retinopathy over the traditional detection approaches. Recently, numerous advanced studies related to the identification of DR have been reported. This paper presents a detailed review of the detection of DR with three major aspects; retinal datasets, DR detection methods, and performance evaluation metrics.

Diabetic Retinopathy Detection using Ensemble Machine Learning [11]. points out promising technological advancements for the healthcare and medical sectors, especially in the early detection of many types of illnesses. Each and every disease is best treated when in its earliest stages, such as, and most importantly, Cancer, Diabetic Retinopathy, Cholesterol abnormalities, and many others. Moreover, automatic detection models are time and cost-efficient, which will serve various communities and regions, and can be run by any practitioner once they are familiar with the models processing and how decisions are displayed. In the present work, we introduce a new framework for Diabetic Retinopathy detection using Ensemble Machine Learning.

Detecting Diabetic Retinopathy Using Embedded Computer Vision [12]. The development efforts on an embedded vision algorithm that can classify healthy versus diabetic retinopathic images. Convolution neural network and a k-fold cross-validation process was used. We used 88,000 labelled high-resolution retina images obtained from the publicly available Kaggle/EyePacs database. The trained algorithm was able to detect diabetic retinopathy with up to 76% accuracy. Although the accuracy needs to be further improved, the presented results represent a significant step forward in the direction of detecting diabetic retinopathy using embedded computer vision.

III PROPOSED SYSTEM DESIGN

Convolutional Neural Networks (or ConvNet) are AI feed-forward neural networks that are unexpected. Because of its great precision, CNNs are better suited to visual layout and recognition. YannLeCun, a computer scientist, suggested it in the late 1990s after being disturbed by the human visual perception of viewing objects. The CNN follows a multi-leveled approach, eventually producing a fully coupled layer in which each of the neurons is linked to one another and their yield is managed. We may use the CNN algorithm to assess the correctness of the outcome, as well as the random forest or any other method.

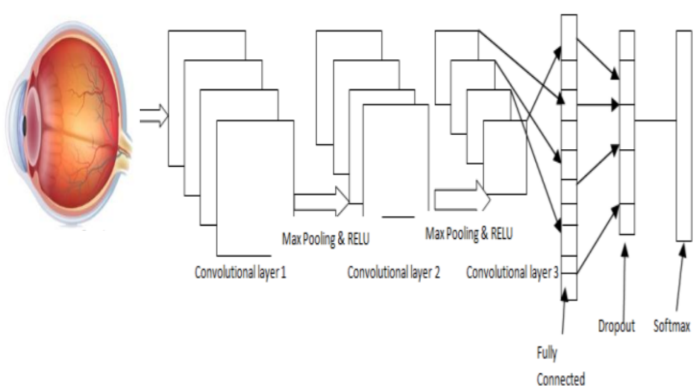

Figure 1 : proposed system architecture

The graphic depicts how the method would be implemented for the diabetic eye images dataset. The dataset is first pre-processed before being trained using the CNN method. The CNN's layer-by-layer operation is as follows:

1. The convolution layer is the first layer of a CNN to which we may feed a pre-processed image to extract the various characteristics of the input image using numerous image filters.
2. Because pictures are nonlinear in form, images are nonlinear as well. In order to keep the nonlinearity, we must apply RELU to it.
3. To get the feature matrix, the eye picture will be pooled and down sampled.
4. The image vector from the pooled picture matrix will be flattened and fed into a fully linked layer.
5. To regularise neural networks, a dropout layer is used to a fully connected layer.
6. The multidimensional picture will be flattened and transformed to vector format, after which the eye condition will be classified into a specific group.
7. For multiclass classification, the softmax function is utilised. (Accurately classifying an input picture into the 5 categories of diabetic retinopathy would be beneficial.)

Algorithms

Input:TrainFeature set {} which having values of train dataset, Test Feature set {} which having values of test dataset, Threshold T, Label L.

Output:classified all instances with weight and label.

Step 1 :Read all features from Test set using below

Step 2: Read all features from Train set using below

Step 3: Read all features from Train set using below

Step 4: Generate weight of both features set

Step 5: Verify Threshold

Selected Instance= result = W > T ? 1: 0;

Add each selected instance into L, when n = null

Step 6: Return L

IV RESULTS AND DISCUSSION

An extensive experimental analysis has been done by deploying the systems on the widows platform with python 3.7 and RESNET100 deep learning framework.

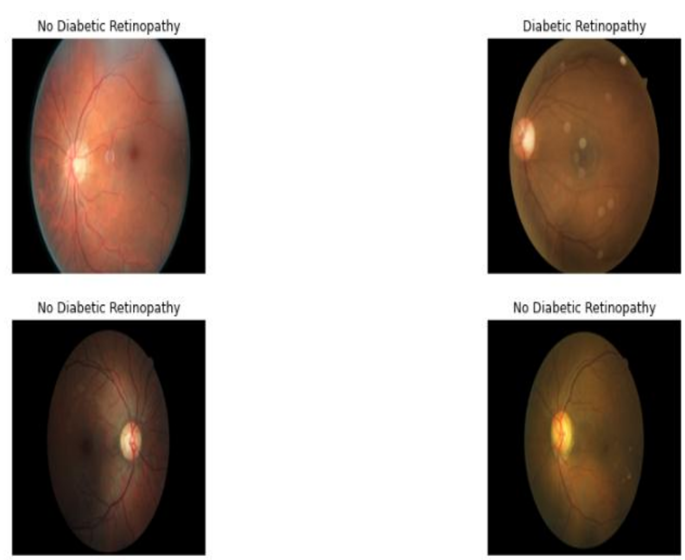

Figure.2 Detection System outcome

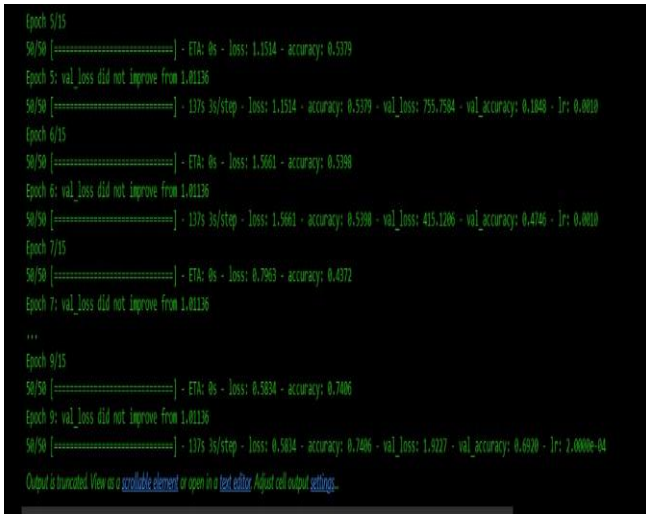

Figure.3 Proposed System Accuracy

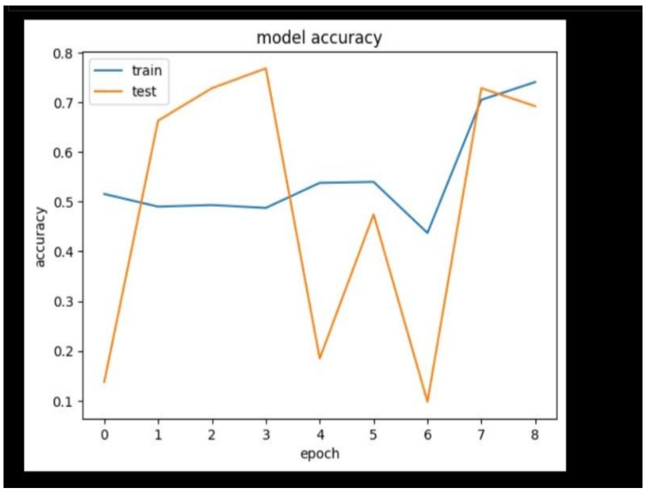

Figure.4 Proposed System Training and Testing Accuracy Model

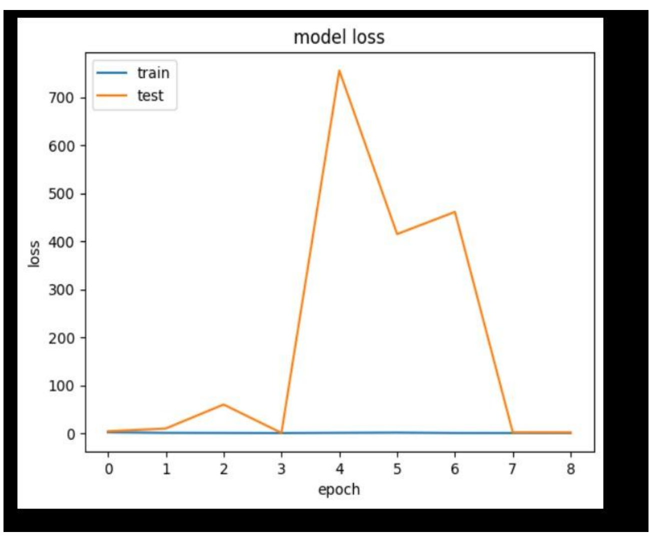

Figure 5 Proposed System Training and Testing Loss Model

V CONCLUSION

The process for determining the exudates of diabetic Retinopathy is described in this study. The CNN algorithm is used to categorise whether the patient's eye is sick or not. The process uses thermal pictures of the iris to provide more precision. This method is very useful for screening diabetic eye disease patients in big numbers. The patient may also determine the stage of diabetic eye illness using this method. Early diagnosis of a sick eye and its stage allows patients to get necessary treatment

VI.REFERENCES

[1]Dipankar Das, Deepak Ranjan Nayak, Ram B. Pachori, "AES-Net: An adapter and enhanced self-attention guided network for multi-stage glaucoma classification using fundus images" , Image and Vision Computing (Elsevier) Volume :146 / / 2024

[2]D. Das, D. R. Nayak, S. V. Bhandary, U. R. Acharya, "CDAM-Net: Channel Shuffle Dual Attention Based Multi-Scale CNN for Efficient Glaucoma Detection Using Fundus Images" , Engineering Applications of Artificial Intelligence (Elsevier)

[3]Farooq, Muhammad Ali, and Peter Corcoran. "Infrared imaging for human thermography and breast tumor classification using thermal images." 2020 31st Irish Signals and Systems Conference (ISSC). IEEE, 2020.

[4]Nazir, Tahira, et al. "Detection of diabetic eye disease from retinal images using a deep learning based CenterNet model." Sensors 21.16 (2021): 5283.

[5]Hasan, Dathar A., et al. "Machine Learning-based Diabetic Retinopathy Early Detection and Classification Systems-A Survey." 2021 1st Babylon International Conference on Information Technology and Science (BICITS). IEEE, 2021.

[6]Thorat, Rohit, et al. "SVM BASED METHOD FOR DIABETIC EYE DISEASE DETECTION." INTERNATIONAL JOURNAL 5.12 (2021).

[7]Liu, Xulong, Yanli Wang, and Jingmin Luan. "Facial Paralysis Detection in Infrared Thermal Images Using Asymmetry Analysis of Temperature and Texture Features." Diagnostics 11.12 (2021): 2309.

[8]Sarki, Rubina, et al. "Automatic detection of diabetic eye disease through deep learning using fundus images: A survey." IEEE Access 8 (2020): 151133-151149.

[9]Dharmana, Meher Madhu, and M. S. Aiswarya. "Pre-diagnosis of Diabetic Retinopathy using Blob Detection." 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA). IEEE, 2020.

[10]Mateen, Muhammad, et al. "Automatic detection of diabetic retinopathy: a review on datasets, methods and evaluation metrics." IEEE Access 8 (2020): 48784-48811.

[11]Odeh, Israa, Mouhammd Alkasassbeh, and Mohammad Alauthman. "Diabetic Retinopathy Detection using Ensemble Machine Learning." 2021 International Conference on Information Technology (ICIT). IEEE, 2021.

[12]Vora, Parshva, and Sudhir Shrestha. "Detecting diabetic retinopathy using embedded computer vision." Applied Sciences 10.20 (2020): 7274.