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Detection And Classification Of Red Lesions From Retinal Images For Diabetic Retinopathy Detection

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ABSTRACT

This work presents the automatic elucidation and categorization of red lesions in retinal images as a supporting mechanism to diagnose diabetic retinopathy (DR). Early identification of diabetic retinopathy is critical for preventing loss of vision, as it is among the most common causes of visual impairment in patients with diabetes. The critical indicators for DR grading and diagnosis are the red lesions, such as microaneurysms, hemorrhages, and exudates. The Proposed system uses CNN to detect and classify stages of the DR, from No_DR to DR using advanced deep learning on retinal fundus images especially in DR Detection. The methods include preprocessing to filter and improve input images, feature extraction using denoised retinal images with deep learning-based CNNs, followed by utilization of TensorFlow/Keras frameworks for training the model. Retinal images are trained by a standardized dataset to test and strengthen robustness. Thus, this work provides a viable solution to the design of automatic detection and categorization of diabetic retinopathy, which has a significant impact on the early diagnosis and blindness of diabetic patients.

KEYWORDS: Deep Learning, CNN, TensorFlow

INTRODUCTION:

Diabetic Retinopathy (DR) is a sight-threatening diabetic microvascular complication that leads to vision loss or blindness, when it is not diagnosed and treated early enough. Red lesions on the retina, including microaneurysms, are indicative of this condition, along with other retinal features and forms of hemorrhage. Red lesions are the important parameters for the diagnosis and severity/progression stage of DR. The project, "Detection and Classification of Red Lesions from Retinal Images for Diabetic Retinopathy Detection," includes a system that processes images of the retina to detect red lesions using modern algorithms for image detection and classification. This task involves accurately detecting and classifying these red lesions and is particularly useful in the early diagnosis and management of DR, the proposed system employs Convolutional Neural Networks (CNNs) to extract features from the retinal images and also classify DR presence and stage based on these features, through preprocessing with normalization and noise reduction, only high-quality input data is fed into the system, which increases detection accuracy. Publicly available retinal image datasets allow for the creation of a suitably generalizable dataset in many patient populations. This work described in the manuscript advances the field of healthcare by creating a low-cost, accurate and scalable tool to assist an ophthalmologist with identifying cases of diabetic retinopathy. A system such as this might lead to early intervention that could afford potential both to prevent the loss responsible for vision as well as to equip patients with diabetes with the knowledge to enhance their quality of life."

OBJECTIVES:

The aim of the project named "Detection and Classification of Red Lesions from Retinal Images for Diabetic Retinopathy Detection" is to create an automated early detection method for diabetic retinal disease (DR) through RED Lesion detection including micro-aneurysms, hemorrhage and exudates in retinal fundus images. Deep learning plays a significant role in the early-stage detection and treatment of these lesions while the system can accurately identify and classify these lesions. To help grade the condition, the study also tries to find out how to assign retinal images into groups of different DR severity like No DR, Mild DR, Moderate DR, and Severe DR, and Proliferative DR.

LITERATURE REVIEW:

One of the most common and devastating ocular complications of diabetes is diabetic retinopathy (DR), unrecognized and untreated, can lead to irreversible blindness. Recent advances in the deep learning area were added to traditional methods based on the manual analysis, asserting a new paradigm in this field with automated diagnostic solutions that are accurate and can be performed on a large-scale. In this review, we cover the evolution of DR detection methods, and the potential of deep learning algorithms to improve diagnosis.

Title: *Diabetic Retinopathy: Evidence-Based Management*
Authors: David J. Browning
Description: This comprehensive resource provides an in-depth overview of diabetic retinopathy, including traditional detection methods. It covers early diagnosis, management, and the importance of follow-up visits, emphasizing the role of regular screening and fundus evaluation in preventing vision loss.

Title: *Detection of Diabetic Retinopathy Using Deep Learning: Diabetic Retinopathy*
Authors: Karpagameenakshi G., A. Vimala Juliet
Description: This book focuses on deploying a deep learning technique called Convolutional Neural Network (CNN) for determining the level of diabetic retinopathy with accuracy. It discusses the use of fundus image datasets and pre-processing methods to enhance model performance in classifying diabetic retinopathy stages.

Title: *Deep Learning Fundus Image Analysis for Diabetic Retinopathy and Macular Edema Grading*
Authors: Jaakko Sahlsten, Joel Jaskari, Jyri Kivinen, Lauri Turunen, Esa Jaanio, Kustaa Hietala, Kimmo Kaski
Description: This paper addresses challenges in medical image analysis, including issues related to irregular image sizes and contrast variations. It discusses pre-processing methods such as image normalization and histogram equalization to enhance image quality for accurate diagnosis of diabetic retinopathy and macular edema.

Title: *Advances in Computer-Aided Diagnosis of Diabetic Retinopathy*
Authors: Saket S. Chaturvedi, Kajol Gupta, Vaishali Ninawe, Prakash S. Prasad
Description: This review paper explores computer-aided detection systems for diabetic retinopathy, focusing on the identification and classification of red lesions such as microaneurysms and hemorrhages. It provides insights into various methodologies, including deep learning techniques, and their effectiveness in detecting retinal abnormalities.

Applying Real-life Examples and Execution:

Screening tools for DR using AI-based data have shown high sensitivity and specificity upon the application to clinical practice. Since it advances accuracy with few datasets, transfer learning has changed the way deep learning algorithms are trained. Our project consists of a GRADIO based user interface, which provides the real-time detection of DR, making it able to deploy.

Challenges and Future Research:

These challenges include variations in imaging, interpretability of the model and real-time processing constraints. Pretrained models like VGG16, ResNet, and InceptionV3 can be adapted for DR classification, achieving higher accuracy compared to traditional methods.

In conclusion, the manual DR detection has been replaced by automated ones, including CNN-based classification which highly improve diagnostic accuracy. Our work contributes to on-going efforts, leveraging deep learning, feature extraction, and real-time classification interfaces for effective and scalable DR identification.

METHODOLOGY:

The name of a project is "Detection and Classification of Red Lesions from Retinal Images for Detection of Diabetic Retinopathy".
The project is constructed upon these important modules: Each module is a step in the evolution of the system:

1. **Image Preprocessing:**
   Objective: Improvement of Raw Retinal Images for Precise Detection & Image Classification
   Steps Involved:
   1) Loading & Label Mapping – Here we load the dataset and map the labels for binary (No_DR, DR) and multi-class (Mild, Moderate, Severe, Proliferative_DR) classification.
   2) Both data stratification to split into Train(70%),Validation(15%),Test(15 %) to maintain class balance and avoid bias.
   3) Organizing Images – We arrange images into folders (train/ val/ & test/) to classify them and to load them faster.
   4) Resizing & Normalization (Resize the images to: 224x224 pixels; if [0,1] then the pixel values, which generally suffice)
      For example: Handling Class Imbalance, data augmentation and weighted loss functions etc
   5) Image Loading through ImageDataGenerator – Provides real-time image preprocessing and augmentation to reduce memory.
   6) The preprocessing stages make certain that clean, standard, and well-formatted input images to make the model more accurate and efficient as it

advances toward Diabetic Retinopathy detection.

2. **The Feature Extraction Purpose:**

Objective: Extract representative image features to recognize the red lesions.

Steps Involved:

1) Convolutional Neural Networks (CNN):
Use convolutional layers to capture spatial features related to red lesions, like edges, textures, and patterns.
2) Apply successive convolutional layers to extract hierarchical features, from design ranges (edges) over to lesion designs (high ranges).
3) Activation Functions: Add non-linearity in feature extraction using activation functions like Relu,softmax.
4) Pooling Layers: Reduce the feature maps through max pooling or average pooling to decrease computational loads without losing important data.
5) This means generating features maps by taking input images and highlighting the region of lesions used on your classification.

3. **Model Training:**

Objective: The objective of this study is to train a CNN based model to classify retinal images at different stages of diabetic retinopathy.

Steps Involved:

1) Dataset Preparation: For training & testing, used a labeled dataset of retinal images like DIARETDB1 or IDRID etc.
2) Model Architecture: Here we use a CNN architecture with the help of convolutional, pooling, dropout and fully connected layers.
3) Transfer learning; transfer learning with pre-trained models like ResNet, VGG16, or Inception to improve accuracy.
4) Fit your model with a suitable optimizer and also loss function to decrease classification mistake.
5) Validation: All While training the model on the training set use a separate validation set to measure for overfitting and pass them the hyper parameters for ex: learning rate, batch size.

4. **Evaluation Purpose:**

Objective: Provide quantitative measures to evaluate performance.

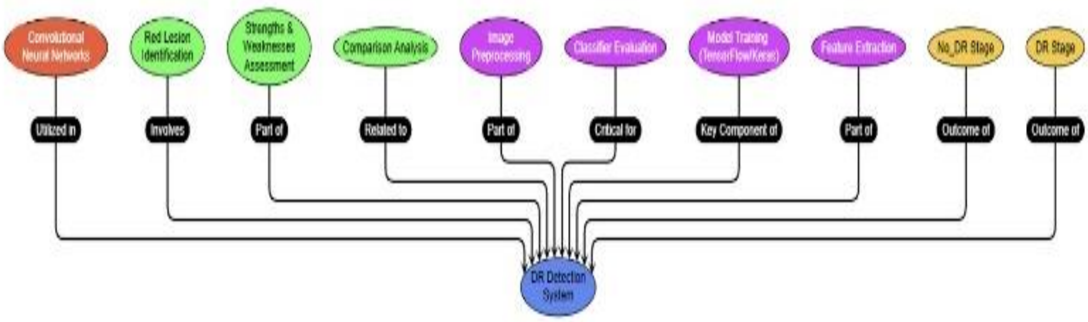
Steps Involved:

1) Metrics: When it comes to evaluation metrics, you can consider the following:
2) Accuracy: The percentage of the total predictions correct.
3) Recall: Proportion of positive cases correctly identified.
4) Specificity: The performance to identify negative cases.
5) So precision is the proportion of true positive predictions.
6) F1-Score: The harmonic means of precision and recall.
7) Confusion Matrix: Visualize the model performance across classes.

RESULT AND ANALYSIS:

This technology is used in the medical field to automatically detect diabetic retinopathy, as it uses deep learning and artificial intelligence (AI). Using CNNs and advanced imaging logic, the system correctly identifies and classifies red lesions in retinal photos, facilitating early detection and prompt clinical intervention.

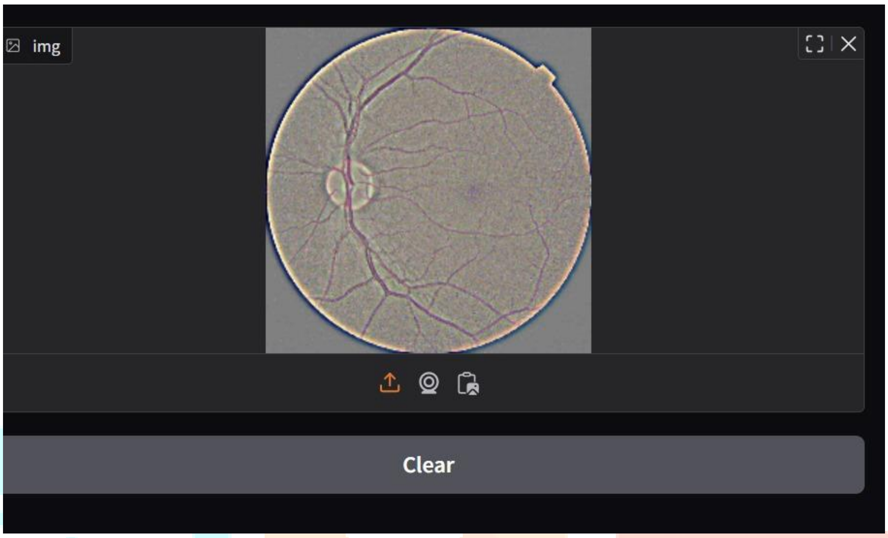
Such a system is scalable, fast and low-cost compared to current methods of diagnosis, which are still often subjective and time-consuming, and will be particularly useful where researchers want to target remote and resource-poor areas. It reaches reliable accuracy (sensitivity/specificity) under well-established evaluation criteria & standard datasets, so it can be used clinically.



The addition of the Gradio interface for the model only further improves usability, allowing even non-technical users to easily access the model.

	Accuracy	Precision	Recall	F1-Score
DR	0.94	0.90	0.94	0.92
No_DR	0.94	0.93	0.90	0.91

FINAL OUTPUT:



REFERENCES:

[1] Agarwal S, Bhat A (2022) A survey on recent developments in diabetic retinopathy detection through integration of deep learning. Multimed Tools

Appl:1–31. https://doi.org/10.1007/s11042-022-13837-5

[2] Chetoui M, Akhloufi MA (2020) Explainable end-to-end deep learning for diabetic retinopathy detection across multiple datasets. J Med Imaging (Bellingham) 7(4):044503

[3] Choong KH, Basah SN, Yazid H, Safar MJA, Ahmad Saad FS, Lim CC (2022) Performance analysis of multi-level thresholding for microaneurysm detection.

Multimed Tools Appl 81:31161–31180

[4] Dayana AM, Emmanuel WRS (2022) An enhanced swarm optimization-based deep neural network for diabetic retinopathy classification in fundus images.

Multimed Tools Appl 81:20611–20642.

[5] Gonzalez-Gonzalo C, Sanchez-Gutierrez V, Hernandez-Martínez P, Contreras I, Lechanteur YT, Domanian A, van Ginneken B, Sanchez CI (2020) Evaluation of a deep learning system for the joint automated detection of diabetic retinopathy and agerelated macular degeneration. Acta Ophthalmologica

98(4):368–377

[6] Latha D, Bell TB, Sheela CJJ (2022) Red lesion in fundus image with hexagonal pattern feature and two-level segmentation.

Multimed Tools Appl 81:26143–26161.

[7] Lavanya D, Derwin DJ, Remya R, Shan BP, Singh OJ, Umamaheswari K (2022) Diagnosis of Early-Stage Diabetic Retinopathy in Digital Fundus Images, 2022 Second International Conference on Advances in Electrical, Computing.
Communication and Sustainable Technologies (ICAECT), pp 1–5.

[8] Prabha S, Sasikumar S, Leela Manikanta C (2022) Diabetic Retinopathy Detection Using Automated Segmentation Techniques. J Phys Conf Ser 2325:012043

[9] Li, X.; Hu, X.; Yu, L.; Zhu, L.; Fu, C.W.; Heng, P.A. CANet: Cross-disease Attention Network for Joint Diabetic Retinopathy and Diabetic Macular Edema Grading. IEEE Trans. Med Imaging 2020, 39, 1483–1493.

[10] Dekhil, O.; Naglah, A.; Shaban, M.; Ghazal, M.; Taher, F.; Elbaz, A. Deep Learning Based Method for Computer Aided Diagnosis of Diabetic Retinopathy. In Proceedings of the IST 2019—IEEE International Conference on Imaging Systems and Techniques, Abu Dhabi, United Arab Emirates, 9–10 December 2019; pp. 1–4.

[11] He, A.; Li, T.; Li, N.; Wang, K.; Fu, H. CABNet: Category Attention Block for Imbalanced Diabetic Retinopathy Grading. IEEE Trans. Med. Imaging 2020, 40, 143–153.

[12] Bodapati, J.D.; Shaik, N.S.; Naralasetti, V. Composite deep neural network with gated-attention mechanism for diabetic retinopathy severity classification. J. Ambient. Intell. Humaniz. Comput. 2021, 1–15.

[13] Hsieh, Y.T.; Chuang, L.M.; Jiang, Y.D.; Chang, T.J.; Yang, C.M.; Yang, C.H.; Chan, L.W.; Kao, T.Y.; Chen, T.C.; Lin, H.C.; et al. Application of deep learning image assessment software VeriSee™ for diabetic retinopathy screening. J. Formos. Med
Assoc. 2021, 120, 165–171.

[14] Alyoubi, W.L.; Shalash, W.M.; Abulkhair, M.F. Diabetic Retinopathy Detection through Deep Learning Technique: A Review. Inform. Med. Unlocked 2020, 20, 1–11.

[15] Anton, N.; Dragoi, E.N.; Tarcoveanu, F.; Ciuntu, R.E.; Lisa, C.; Curteanu, S.; Doroftei, B.; Ciuntu, B.M.; Chiseli¸t˘ a, D.; Bogd˘anici, C.M. Assessing Changes in Diabetic Retinopathy Caused by Diabetes Mellitus and Glaucoma Using Support Vector Machines in Combination with Differential Evolution Algorithm. Appl. Sci. 2021, 11, 3944.