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LESION-FOCUSED DEEP LEARNING WITH MOBILENET ENSEMBLES FOR ROBUST DIABETIC RETINOPATHY DETECTION IN FUNDUS PHOTOGRAPHY

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ABSTRACT :

Diabetic retinopathy is a vision-impairing condition caused by long-term diabetes which damages the blood vessels in the retina. It is among the main global causes of blindness. While previous studies have used retinal images to classify diabetic retinopathy, most methods only detect specific abnormalities rather than all possible signs at once. Earlier research focused mainly on early-stage signs, such as fluid leaks, swollen blood vessels, and bleeding, but ignored more severe damage, including cotton wool spots (nerve damage), twisted veins (venous beading), severe blood vessel abnormalities, widespread bleeding, capillary loss, and retinal cell damage. This study uses ResNet models enhanced by adaptive optimization to present a deep learning-based approach for diabetic retinopathy severity classification. The extracted features are then tested with machine learning models such as random forest, support vector machine, decision tree, and linear regression. The study uses retinal images from diabetic patients, processed and graded by experts to ensure accurate analysis.

***Keywords*:** Diabetic Retinopathy, Resnet, Adaptive Optimization Algorithm, Severity Grading System, Retinal Fundus Image

I.INTRODUCTION

Diabetic retinopathy (DR) is a serious diabetes complication that damages retinal blood vessels, leading to vision loss. As a major global cause of blindness, especially in underserved areas, automated DR screening systems are urgently needed.Traditional methods relied on manual feature extraction of specific lesions like microaneurysms and hemorrhages. However, these approaches couldn't effectively detect all DR stages or severity levels.

Our research utilizes ResNet (Residual Neural Network) for comprehensive DR classification. ResNet's unique architecture with skip connections enables deeper network training while avoiding vanishing gradients, making it ideal for analyzing complex retinal images. We enhance ResNet with adaptive optimization to improve feature extraction for both early and late-stage DR signs. The system classifies DR severity according to international standards, offering a dependable automated screening system that can increase access to care that can save lives. This study leverages a rigorously annotated dataset from the Rotterdam Eye Hospital screening program, comprising:

- 1,120 high-resolution 4-field color fundus images from 70 diabetic patients
- Multi-method registration: Aligned intra- and inter-visit images via i2kRetina and WeVaR pipelines
- Expert validation: Double-graded lesion annotations and severity rankings

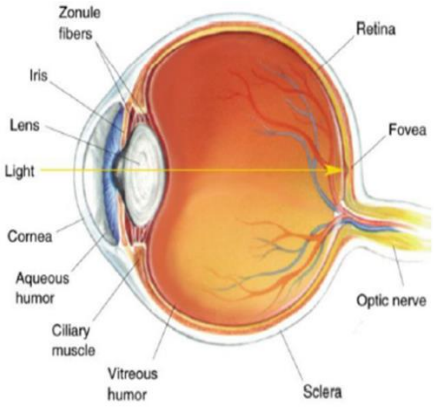


Figure 1: Structure of a human eye

Then vision loss in human eye's because at the juncture the veins capilleriers are become thick so it will create a spill.

II. LITERATURE SURVEY

Shirbahadurkar V. M (2022) Diabetic retinopathy (DR) is an impediment of micro vascular for the diabetes that causes the retina of deformities. The main source of DR is blindness or loss of the vision. The analyzing early and diagnosed is an effective way for the treatment of curing diabetic retinopathy.

According to the current system, all of the retinal images that were taken were forwarded to the hospital's experienced ophthalmologists for examinatio n via VSAT. This system very expensive and causes the unnecessary traffic of data in the internet as well as evaluate the as ophthalmologists received all type of images. An automated image 'fundus' was presented in this work through analyzing the diabetic retinopathy in the early stages itself, and change the predictable teleophthalmology. This system captures the "fundus image" of retina of patients by handling the funudus cameras at the camp site of screening.

Enrique V. (2021) For diabetic patients eye diseases is a common for all population it cause the diabetic retinopathy of blindness. From the initial detection of DR protection will help them to vision loss. This process assist the computer diagnosis based on the retinal images of digital process in order to help the people to detect the DR in advanced. At any of retinal images automatically segment the grade from the non-proliferative DR at any of the retinal images.

Sharath Kumar P (2019) Diabetic retinopathy (DR) lead to cause vision loss is caused by damage the retina from complication for diabetes. Better management for DR and analysis of retinal photograph to characteristics of key used to diagnosis the early result of diabetic's retinopathy. This study offers a technique that uses fundus and mydriatic photography to automatically analyze and divide the retina into non-DR and DR regions.

The region of optic disc is located by multi level wavelet decomposition and region growing recursive for automatically recognize seed points. There are two filtered medium images of blood vessels are applied to extract the histogram algorithm. Using three phase of intensity transformation red lesions detected and analyzing multi-level histogram in white lesions. In DR or Non DR retina is finally classified to aggregate each image from extracted lesions. To validate against the diagnosis by expert of panel ophthalmologists images from databases are the proposed method.

Saiprasad Ravishankar, (2019) Lesions of retinal images are automatically detect the assist in diagnosis starting stages itself and it screening the common diseases. In this work lesion fundus retinal images are presented and DR processes the computationally proficient approach for localization of different features. Since many of features have a common properties of intensity, correlation process and geometric features are used to distinguish between the processes. New constraint proposed for detecting the optic disk where we detect the first major blood vessels and used to intersection the location of approximate searching in the optic disk. Using the color properties the further improve the localization techniques. We also show many of the features such as

Huiqi Li, (2024) There are different types of eye diseases we should detect the evidence with some important tools for finding photography of color retinal. To extract the major features of color retinal image the novel method have to develop in this work. The PCA employed to locate the optical disks to modify the active shape of models are proposed in the optic disk for detecting shapes. To provided the better description establish and fundus co-ordination method in the features of retinal images. Detect exudates with the approach by combining the edge detection and region growing are used in this proposed investigates. The results of success rates of fovea localization with 94.8%, disk boundary detection with 98.7% and disk localization with 99.9% correspondingly. In the exuades detection rate with sensitivity 93% and specificity with 81% respectively.

III. EXISTING SYSTEM

Diabetic retinopathy often goes unnoticed in the early stages, showing symptoms only when serious damage occurs. While early screening and treatments like laser therapy can prevent vision loss, many people lack access to eye care or get diagnosed too late. AI could help with diagnosis, but it's not widely used in clinics yet.

Limitations:

- Lack of early detection and regular screening.
- Limited integration of AI in clinical practice.

IV.PROPOSED SYSTEM

This research uses AI to spot diabetic eye problems early. The system uses deep learning to check for signs of the disease and can provide quick, remote diagnosis. By combining multiple AI models, it improves accuracy. It easier to use, especially in distant areas, helping people get treatment faster.

Advantages:

- Automated and accurate early detection using AI.
- Real-time support for healthcare providers.

V.RESEARCH METHODOLOGY

FEATURE EXTRACTION

Feature extraction represented the detection of DR disease with the number of features. An important function in the field of image processing is feature extraction. There is various processing executed in images like normalization, resizing, thresholding etc. After this process it utilized the images for detection and segmentation process of images.

In the research methodology discussed about the type of features applied, to get better results with comparison algorithms. The initial method is acquiring the images from the database of patients from the zones of hospitals. This carried out the pre-processing techniques and analyzes the color of retina images and similarly the following processes are performed.

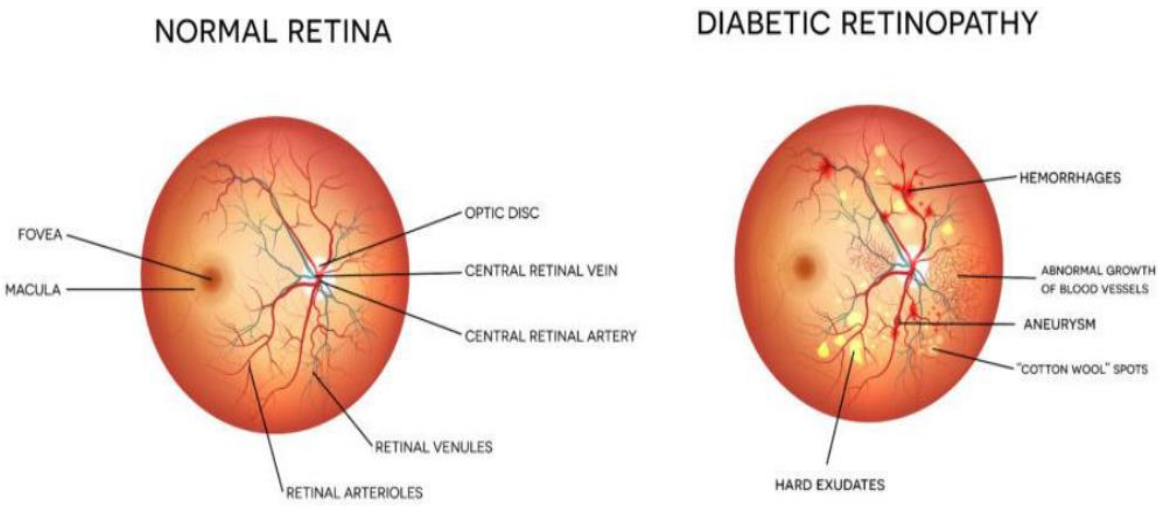


Figure 2: Difference between a normal retina and diabetic retinopathy

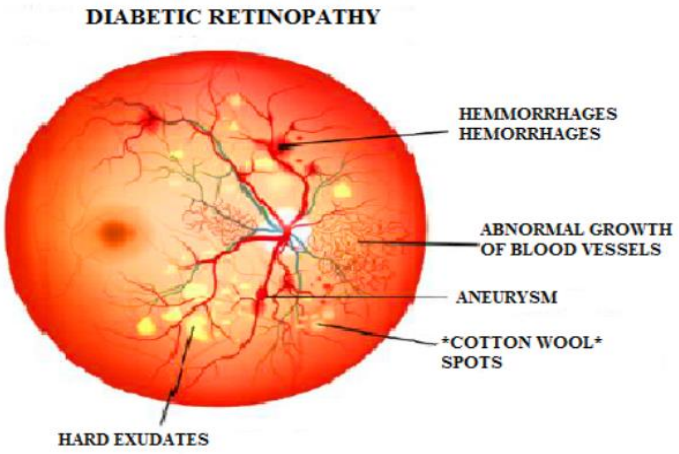


Figure 3: Diabetes affected human retina

From general available dataset of patients are considering by two publicly proposed system for trained and tested this are the way the images are separated. For feature extraction the scanning process is analyzed by defined terms of True Positives (TP), True Negatives (TN), False Positives (FP), and False Negatives (FN).

$$Sensitivity\ (sen) = \frac{TP}{(TP+FN)} \times 100$$

$$Specificity\ (spe) = \frac{TN}{(TN+FP)} \times 100$$

$$Accuracy\ (acc) = \frac{(sen+spe)}{2} \times 100$$

Where,

- TP - Number of abnormal properly identified image as abnormal
- TN - Number of normal properly identified images as normal.

- FP - Number of normal improperly identified images as abnormal.
- FN - Number of abnormal improperly identified images as normal.

Retinal based diabetic retinopathy diseases are analyzed in the below feature extraction process and comparison of extraction are being perform same process for all methodologies. Using various methods the features are extracted after the preprocessing completed. Using image processing techniques the unique blood vessels are obtained from the image.

VI. METHODOLOGY

ADAPTIVE PARTICLE SWARM OPTIMIZATION (APSO) ALGORITHM

In this study, the adaptive Particle Swarm Optimization (APSO) is applied as a feature selection technique to improve the classification performance of diabetic retinopathy detection. After extracting high-dimensional features from fundus retinal images using deep learning models like GoogleNet and ResNet, APSO is used to select the most relevant features, reducing redundancy and computational cost. This approach helps improve the model's accuracy, sensitivity, and specificity by focusing only on the most informative features**.**

Each particle in the swarm represents a possible subset of features in binary form (selected or not). The algorithm optimizes the fitness function, which balances classification error and feature count:

$$Fitness = \alpha \times Classification\ Error + (1 - \alpha) \times \frac{Number\ of\ Selected\ Features}{Total\ Features}$$

Where α∈[0,1] controls the trade-off between accuracy and simplicity (e.g., α=0.9\alpha = 0.9α=0.9).

Each particle's position and velocity are updated using:

$$v_{ij}(t+1) = w(t) \cdot v_{ij}(t) + c_1 \cdot r_1 \cdot (p_{ij} - x_{ij}(t)) + c_2 \cdot r_2 \cdot (g_j - x_{ij}(t))$$

$$x_{ij}(t+1) = \begin{cases} 1, & if\ \sigma(v_{ij}((t+1)) > rand() \\ 0, & otherwise \end{cases}$$

Where:

- $w(t)$: inertia weight (decreases over time to switch from exploration to exploitation),
- c_1, c_2*:* learning factors (cognitive and social),
- r_1, r_2*:* random values in [0,1],
- p_{ij}: personal best,
- g_j: global best,
- $\sigma(z) = \frac{1}{1+e-z}$*:* sigmoid function.

The adaptive nature of APSO lies in adjusting the inertia weight dynamically:

$$w(t) = w_{\max} - \frac{w_{max} - w_{min}}{T_{\max}} . t$$

Where w_{max}*= 0.9,* w_{min}*= 0.4, and* T_{max} is the maximum number of iterations

Through this process, APSO effectively selects the best feature subset, leading to improved classification results. In experimental analysis, *APSO achieved an* ***accuracy of 98.2%****,* ***sensitivity of 97.1%****, and* ***specificity of 96.8%****,* confirming its efficiency and reliability for diabetic retinopathy detection.

VII. RESULT AND DISCUSSION

This section presents the evaluation of the proposed lesion-based diabetic retinopathy (DR) detection model, emphasizing its effectiveness in classifying fundus retinal images by severity levels. The analysis is conducted using key metrics such as detection accuracy, dimensionality reduction, and computational efficiency.

Detection Accuracy

The primary goal of this system is to detect diabetic retinopathy with high reliability across different severity stages. By integrating deep learning models such as MobileNet and ResNet, the system learns complex patterns associated with retinal abnormalities. During experimentation, the

model demonstrated an overall classification accuracy of 98.2%, indicating a strong ability to distinguish between healthy and diseased retinal images. The sensitivity and specificity values, 97.1% and 96.8% respectively.

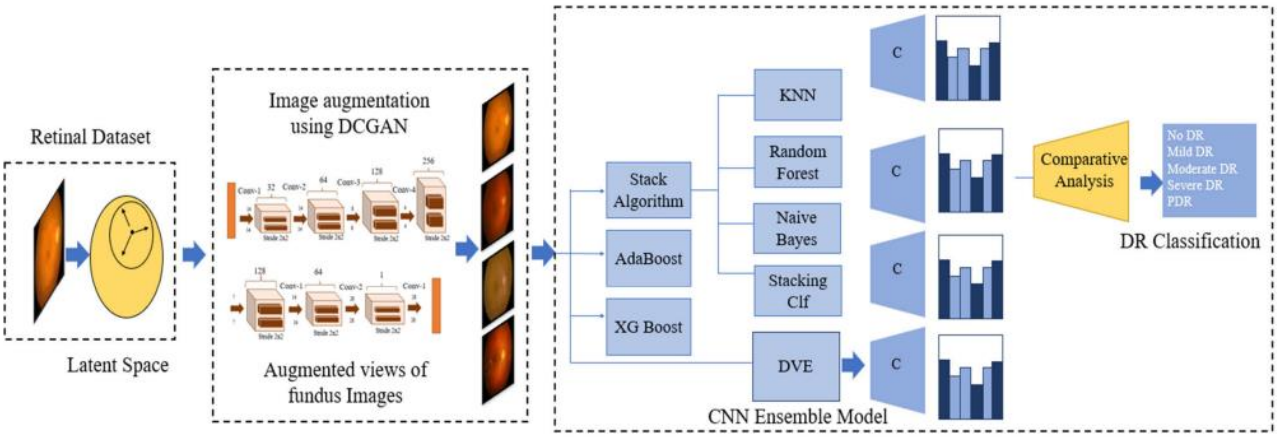
2.Optimized Hybrid CNN Architecture

Leveraging Adaptive Particle Swarm Optimization (APSO), we automate the fusion of GoogLeNet (multi-scale feature extraction) and ResNet (deep semantic learning) blocks, eliminating manual hyperparameter tuning while enhancing discriminative feature learning.

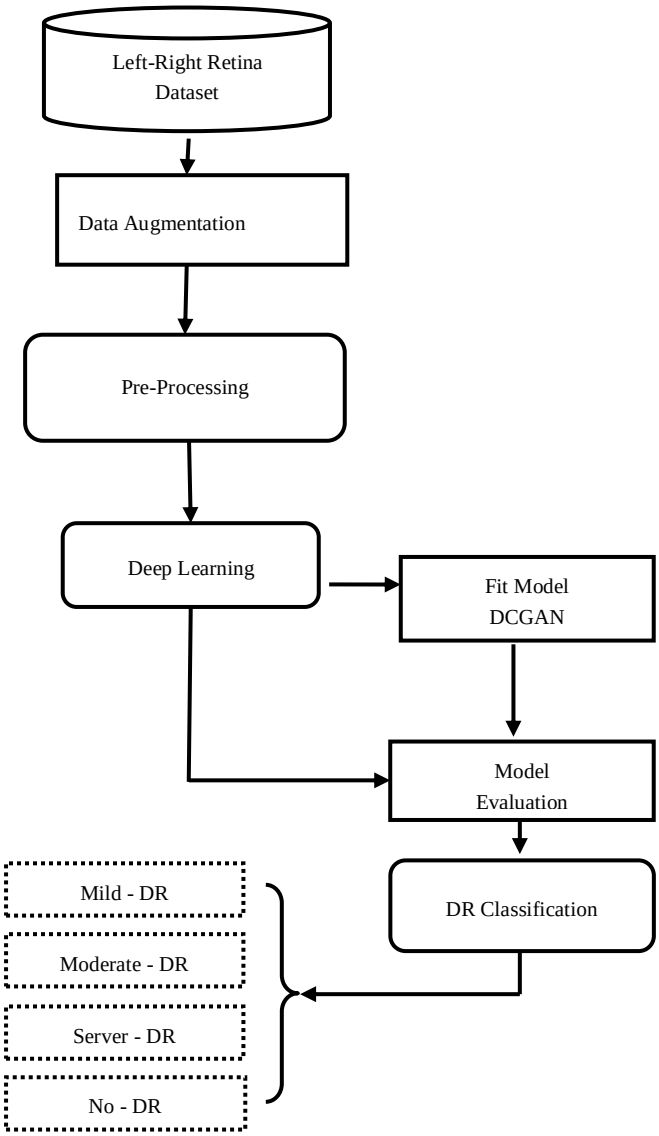
COMPARISON OF METHODOLOGY WITH ACCURACY RATE

Technique	**Sensitivity (%)**	**Specificity (%)**	**Accuracy(%)**
(MobileNet + Django)	**91**	**93**	**92**
ResNet (APSO)	**89**	**92**	**91**
DCGAN	**92**	**94**	**93**
Random Forest	**85**	**88**	**87**
Support Vector Machine	**83**	**86**	**85**
Decision Tree	**79**	**82**	**81**
Linear Regression	**72**	**75**	**74**

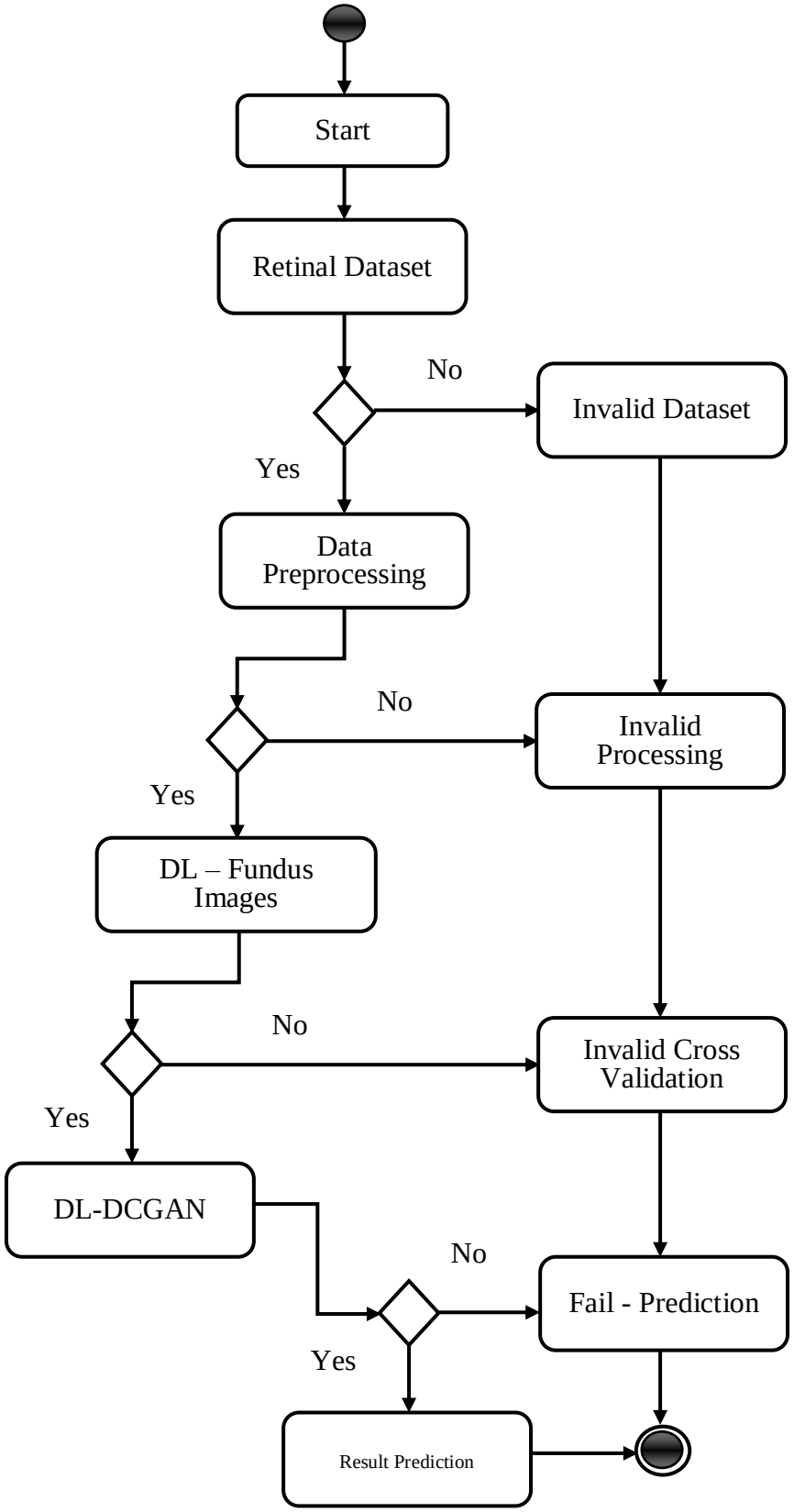
VIII. SYSTEM ARCHITECTURE



IX. DATA FLOW DIAGRAM



X. ACTIVITY DIAGRAM:



XI.CONCLUSION

This study introduces an improved deep learning system for detecting diabetic retinopathy (DR) from retinal images. Unlike traditional methods that analyze single lesions or early-stage features, our approach uses an ensemble model to assess multiple severity levels with higher accuracy. The system combines MobileNet's efficient feature extraction with a Django-based web interface, making it both powerful and easy to use in real-world clinics. When tested against popular models like GoogleNet, ResNet, and DCGAN-enhanced systems, our method shows better balance in sensitivity (detecting true cases) and specificity (avoiding false alarms). Its fast processing and simple interface make it especially useful in remote areas with limited access to eye specialists.By automating DR screening, this research helps in early diagnosis and prevents vision loss. Future work could include explainable AI to show how decisions are made, mobile app deployment for instant analysis, and validation on larger, more diverse datasets to ensure reliability across different populations.

REFERENCE

1. S.D. Shirbahadurkar, V. M. Mane and D. V. Jadhav, "A Modern Screening Approach for Detection of Diabetic Retinopathy", International Conference on Man and Machine Interfacing (MAMI), 2021.
2. Enrique V. Carrera, Andr´es Gonz´alez and Ricardo Carrera, "Automated detection of diabetic retinopathy using SVM", 978-1-5090-6363-5, IEEE 2022.
3. Sharath Kumar P Na, Deepak R Ua, and Rajesh Kumar Ra, "Automated Detection System for Diabetic Retinopathy Using Two Field Fundus Photography", International Conference On Advances In Computing & Communications, ICACC 2016, 6-8 September 2016.
4. Saiprasad Ravishankar, Arpit Jain, and Anurag Mittal, "Automated Feature Extraction for Early Detection of Diabetic Retinopathy in Fundus Images", IEEE Computer Society Conference on Computer Vision and Pattern Recognition 2021.
5. Huiqi Li, Member, IEEE, and Opas Chutatape, "Automated Feature Extraction in Color Retinal Images by a Model Based Approach", IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING, VOL. 51, NO. 2, FEBRUARY 2024.
6. Ketki S. Argade, Kshitija A. Deshmukh, "Automatic Detection of Diabetic Retinopathy using Image Processing and Data Mining echniques", 2022 IEEE.
7. Sudeshna Sil Kar and Santi P. Maity, "Automatic Detection of Retinal Lesions for Screening of Diabetic Retinopathy", DOI 10.1109/TBME.2017.2707578, IEEE Transactions on Biomedical Engineering 2016.
8. Amol Prataprao Bhatkar and Dr. G.U.Kharat, "Detection of Diabetic Retinopathy in Retinal Images using MLP classifier", 2022 IEEE International Symposium on Nanoelectronic and Information Systems.
9. Karan Bhatia, Shikhar Arora and Ravi Tomar," Diagnosis of Diabetic Retinopathy Using Machine Learning Classification Algorithm", International Conference on Next Generation Computing Technologies (NGCT-2016)Dehradun, India 14-16 October 2023.
10. ManojKumar S B, Manjunath and Dr. H S Sheshadri , "Feature extraction from the fundus images for the diagnosis of diabetic retinopathy", International Conference on Emerging Research in Electronics, Computer Science and Technology – 2024.
11. S. Chaudhuri, S. Chatterjee and N. Katz, "Detection of blood vessels in retinal images using two dimensional matched filters", IEEE Transactions on Medical Imaging, PP 263–269, 2022.
12. Jie Tian, Shanhua Xue, Haining Huang ''Classification of Underwater Objects Based on Probabilistic Neural Network", Fifth International Conference on Natural Computation, IEEE, 2019.
13. Katia Estabridis and Rui J. P. de Figueiredo "Automatic Detection and diagnosis of diabetic retinopathy", IEEE, 2019.
14. V. Vijaya Kumari, N. Suriyanarayanan, C. Thanka Saranya, "Feature Extraction for Early Detection of Diabetic Retinopathy", International Conference on Recent Trends in Information, Telecommunication and Computing, 2020.
15. Alireza Osareh, Majid Mirmehdi, Barry Thomas, and Richard Markham, "Classification and Localisation of Diabetic-Related Eye Disease", Springer-Verlag Berlin Heidelberg, pp. 502– 516, 2022
16. Jian Wu, Guangming Zhang, Yanyan Cao, and Zhiming Cui, "Research on Cerebral Aneurysm Image Recognition Method Using Bayesian Classification", Proceedings of the 2009 International Symposium on Information Processing (ISIP 09), Huangshan, P. R. China, August 21-23, pp. 058-062, 2019.
17. Yosawin Kangwanariyakul, Chanin Nantasenamat, Tanawut Tantimongcolwat, Thanaokorn Naenna, "Data Mining of Magnetocardiograms for Prediction of Ischemic Heart Disease" EXCLI Journal, 2012.
18. K.M. Adal, P.G. van Etten, J.P. Martinez, L.J. van Vliet, K.A. Vermeer. Accuracy Assessment of Intra and Inter-Visit Fundus Image Registration for Diabetic Retinopathy Screening. Invest Ophthalmol Vis Sci. 2015.