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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). Early screening is required to slow the disease's 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. Recent studies have utilized convolutional neural networks (CNN), an efficient deep learning algorithm, to detect DR features from retinal images. CNN's approach to DR detection is more efficient and accurate than manual diagnostics, saving time and money. Therefore, CNN is essential and beneficial for DR detection. The suggested approach uses the CNN deep learning technique to diagnose diabetic eye disease by analyzing pictures. We preprocess these photos by transforming them from RGB to GREY and then extract the relevant characteristics. We use the Convolutional Neural Network to detect stages of diabetic retinopathy.

**KEYWORDS:** Retinal disease Neural Networks, Retinal image analysis, Blood Vessel Detection, Image Segmentation, Fundus Image Classification, Feature Selection

## I. INTRODUCTION

Technological advancements are creating new values, particularly in the field of medicine. The retina is the unique non-invasive window into the deep-seated blood vessels of the eye. The retinal fundus picture primarily reveals the retinal blood vessels. Cataracts, diabetic retinopathy (DR), high blood pressure, etc., all have an effect on the body's structure and features, and these variances reflect this. More than half of all cases of vision impairment in the developed world are attributable to cataracts. Typically, this illness only affects very young children. If the diabetic's condition worsens, it could lead to blindness or the need for eye removal surgery. It also discusses chromosomal mutations and their effects. Retinoblastoma may develop in people of any age. We can categorize the illness into heritable and asymptomatic subtypes. It is well known that bilateral retinoblastomas are heritable but unilateral retinoblastomas are not. Diabetic retinopathy, a kind of diabetic eye disease, is a significant problem that may affect diabetic patients. Untimely recognition or treatment of diabetic retinopathy can lead to serious vision loss or even blindness. Changes in the blood vessels of the retina, a light-sensitive tissue located at the rear end of the eye, cause diabetic retinalopathy. The strength of your retina determines how clear your eyesight is. The patient's blood and sugar levels, along with blood pressure changes such as high blood pressure and hypertension, can lead to retinal damage and diabetic retinopathy (DR), ultimately resulting in blindness. The Central Council of Health and Family Welfare conference in October 2019 conducted the latest survey, which revealed that diabetic retinopathy impacts approximately 17 percent of the Indian population. The main emphasis of this article is on utilizing thermal imaging to detect diabetic retinopathy. We will employ a method known as a convolutional neural network for this system. CNN is a deep learning branch that has a number of applications in image processing, including medical imaging. Recently, researchers have enhanced deep learning for computer vision in image diagnostics and classification, utilizing it as a key tool to automate tasks in people's lives. We have systematically built Convolutional neural networks (CNN) to identify objects, segment them, and classify them. Artificial neural networks, known as CNNs, have demonstrated exceptional performance in picture classification and recognition. Researchers have successfully used CNN to analyze visual information, identifying people and objects.

## II. LITERATURE SURVEY

Infrared Imaging for Human Thermography and Breast Tumor Classification using Thermal Images [1]. 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 diseases such 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 [2]. 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 [3]. 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 [4]. a non-invasive procedure has been presented to gauge 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 [5]. 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 [6]. 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 [7].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 [8]. 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 [9]. 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 [10]. 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.

**Summary Table**

Sr. No	Author Names	Summary	Gap
[11]	Shaikh, Shazia, Nazneen Akhter, and Ramesh Manza.	A literature review is presented and their operation in the biomedical applications of infrared thermal imaging to identify and appraise recent biomedical applications that have used intelligent analysis methods such as machine learning processes to classify and perform decision making towards improving existing medical care.	There is a lack of standardized protocols for using thermal imaging in various medical applications, affecting the consistency and reliability of results.
[12]	Vardasca, Ricardo, Carolina Magalhaes, and Joaquim Mendes.	Artificial intelligence (AI) technologies for thermal data interpretation might be an intriguing alternative for providing a second opinion to clinicians in a diagnostic/therapeutic evaluation situation. The purpose of this study was to conduct a comprehensive review and meta-analysis of various biological thermal applications using machine learning methodologies.	The lack of standardized protocols for thermal image acquisition and processing hampers the reproducibility and comparability of results across studies.
[13]	Magalhaes, Carolina, Joaquim Mendes, and Ricardo Vardasca	Diabetic retinopathy (DR) is a potentially blinding eye disorder that affects diabetics. It may harm the retina and ultimately cause irreversible blindness if not detected early. Early detection of DR is critical for effective therapy. Using an autonomous classifier, a breakthrough in the area of artificial intelligence known as deep learning may assist the ophthalmologist in getting a second opinion on the categorization of the DR.	The influence of environmental conditions on thermal imaging outcomes is often overlooked in systematic reviews.
[14]	Kandel, Ibrahim, and Mauro Castelli.	It is critical to have a reliable, automated, and computer-based DR diagnostic. Deep neural networks are now being used to diagnose a variety of disorders in a variety of medical fields. As a result, deep transfer learning is used in this paper. Five convolutional neural network-based architectures are used (AlexNet, GoogleNet, Inception V4, Inception ResNet V2 and ResNeXt-50). A collection of DR	A significant gap in the research is the lack of diverse and large-scale datasets. Current studies rely heavily on a few public datasets, leading to potential bias in model training and evaluation.

		photographs is made. Following that, the formed collections are labelled using a treatment strategy that is suitable. This simplifies the diagnosing process and aids patients in completing their treatments.	
[15]	Tariq, Hassan, et al	Telemedicine has risen to the forefront of healthcare services as a result of the present COVID-19 epidemic. As a result, many more people may benefit from more convenient and quicker access to ophthalmic expert treatment. The goal of this research was to perform a narrative literature review over the past 20 years on existing DR screening programmes and registries in the European Union.	The performance analysis of deep neural network-based systems for diabetic retinopathy diagnosis will enable more accurate, explainable, and reliable tools for healthcare professionals.

### III. RESEARCH METHODOLOGY

In the proposed research work to design and implement a system that can provide eye diabetic disease detection using deep learning, the procedure carried out various features extraction using image segmentation and the use of CNN deep learning classification algorithm to detect the actual disease. Convolutional Neural Networks, also known as ConvNet, are artificial intelligence feed-forward neural networks. Because of their outstanding precision, CNNs are better suited to visual layout and recognition. A computer scientist proposed CNNs as a solution to the challenge of human visual perception during object viewing. The CNN employs a multi-leveled approach, ultimately creating a fully coupled layer that links each neuron to its counterpart and manages their yield. To assess the accuracy of the results, we can use either the CNN algorithm or the random forest method. In the proposed research work, we designed and implemented a system to detect diabetic eye disease using thermal images. The system carried out various feature extractions using image segmentation and then used a CNN deep learning classification algorithm to detect the actual disease.

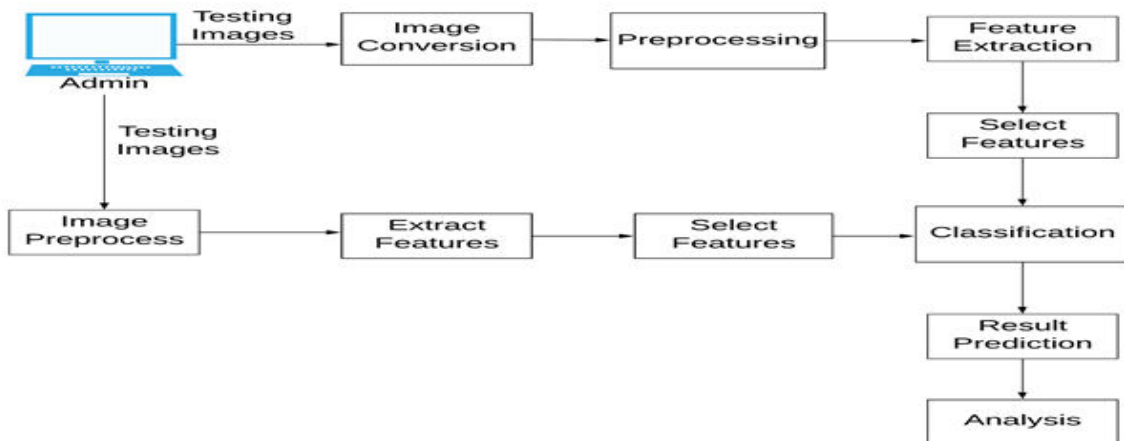


Figure 1: Research methodology of proposed system

#### Implement Process

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 also nonlinear.

3. The eye picture will be pooled and down-sampled to get the feature matrix.
4. The image vector from the pooled picture matrix will be flattened and fed into a fully linked layer.
5. A dropout layer is used as a fully connected layer to regularise neural networks.
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 five categories of diabetic retinopathy would be beneficial.)

#### IV. APPLICATIONS

- EyePACS Application: It's like a license-free Web-based DRS system designed to simplify the process of image capture, transmission, and review. The system provides a flexible platform for collaboration among clinicians about diabetic retinopathy.
- Diabetic detection application
- Disease prediction using IoT and ML for diabetic retinopathy systems.

#### V. CONCLUSION

Automated techniques for diabetic retinopathy diagnoses are essential to solving these problems. While deep learning for binary classification generally has achieved high validation accuracies, multi-stage classification results are less impressive, particularly for early-stage disease. The system also works on the image as normal RGB and greyscale images. From a computer perspective, retina processing is reviewed with several methods and process steps. They are important. Divide the blood vessels as an image that can be used to identify the right disease. The resulting image is summarized in the accompanying problem with problems such as brightness and contrast of the result. Therefore, improving overall performance by focusing on pre-processing and extracting results is essential. The automated Diabetic Retinopathy diagnosis system is thus used to detect various lesions of the retina, i.e. exudates, micro aneurysms and haemorrhages, and their count size and location to assess the severity of the disease so that the patient can be diagnosed early and referred to the specialist well in advance for further intervention. Certain features present in the normal physiology of the retina have to be differentiated from the abnormal pathology, e.g., the optic disc has the same pixel brightness as the exudates and thus has to be localized before establishing the presence of the exudates. Similarly, the blood vessel and fovea region must be subtracted from the retinal image before diagnosing micro aneurysms and haemorrhages. Finally, the CNN Algorithm predicts the good classification accuracy of the system.

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