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Diabetic Retinopathy Prediction Using Deep Learning

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Abstract - Diabetic retinopathy is a devastating eye condition caused by high blood sugar levels that eventually leads to blindness. This illness will impair the retina's light sensitive tissues. The blood arteries in the eyes will get clogged, resulting in fluid leaking. This condition affects persons who have been diabetic for more than twenty years. At first, there are no signs of this condition. Cloudy vision or moderate blindness may develop later. The use of early detection as a possible treatment for this condition. We can avoid blindness if it is discovered early. The therapies and technology available in today's environment take time. This mechanism is incapable of detecting illness at an early stage.We propose an artificial-intelligence-based system that can forecast the emergence of illness using retina scans. The suggested system would divide illness phases into five groups and generate output accordingly. This can aid in the detection of diabetic retinopathy at an early stage, perhaps avoiding the disease's risk factor.

1. INTRODUCTION

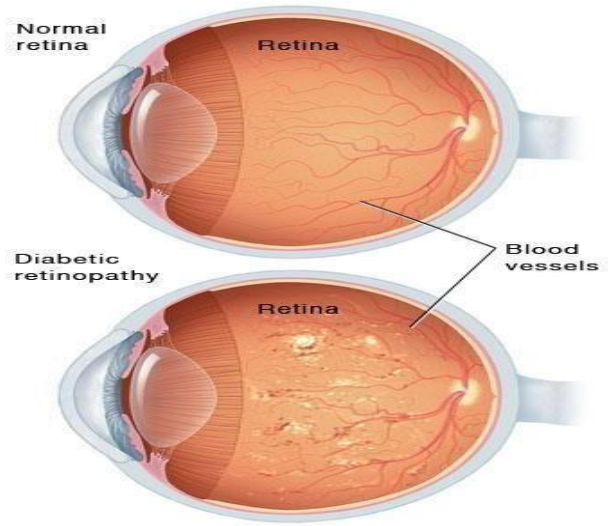
1.1 Introduction

Diabetic Retinopathy is a devastating eye illness associated with long-term diabetics that causes gradual retinal degeneration and finally blindness. According to recent research, diabetic retinopathy affects up to 80% of those who have had high blood sugar for 20 years or more. The World Health Organization estimates that 347 million individuals worldwide are infected with the illness. Diabetes retinopathy develops as a result of elevated blood sugar levels, which disrupt the neurons in the retina. This sickness is hazardous since it can cause blindness. A possible remedy is illness discovery at an early age. This may be accomplished using various machine learning techniques.

Diabetic retinopathy, commonly known as diabetic eye disease, is a condition in which the patient's eye retina is damaged as a result of diabetes mellitus or excessive blood sugar levels. Diabetic retinopathy can occur in both types of diabetics in humans. Diabetics are classified into two types: type 1 and type 2. In general, the immune system defends the body against outside invaders such as viruses and bacteria. The immune system misidentifies our body's own healthy cells as hazardous viruses and bacteria in type 1 diabetics. The immune system targets and kills beta cells in the pancreas, which create insulin. When beta cells die, the body is unable to create insulin. This results in type 1 diabetes.

Type 2 diabetes is not caused by a decrease in insulin resistance. Type 2 diabetics create insulin in their bodies but are unable to utilise it effectively. When the body is unable to utilise the insulin that is available, the pancreas of a type 2 diabetes patient produces more insulin. At initially, diabetic retinopathy causes no symptoms or just minor vision abnormalities. It can eventually lead to blindness. Laser therapy, eye injections, and eye surgery are currently possible therapies for diabetic retinopathy. Additional options include prevention and early detection. To avoid diabetic retinopathy, we should eat a well-

balanced diet and live a healthy lifestyle.



Purpose of Study:

The suggested system's goal is to develop an Artificial Intelligence-based model for detecting diabetic retinopathy utilising colour fundus photography as input. While there is presently no solution for the condition, early detection of the stage of Diabetic Retinopathy helps lower the risk of visual loss. The model developed for this research would categorise the disease into five phases, allowing the clinician to prescribe appropriate therapy. The phases of illness are classified as no diabetic retinopathy, mild diabetic retinopathy, moderate diabetic retinopathy, severe diabetic retinopathy, and proliferative diabetic retinopathy. This can assess the patient's illness status and provide appropriate therapy.

1.2 Objective

This is the focus of this project. Understanding diabetes at an early stage using this paradigm can aid in the provision of early treatment. This model, which will be taught with artificial intelligence, may be employed in a variety of ways for this aim. The research has the potential to identify illness at an early stage. Diabetic retinopathy is a prominent cause of blindness in the modern world. With this option, you may be able to adjust or minimise the severity of the issue.

2. Literature Survey

They suggested a diabetic retinopathy prediction system based on certain algorithms and a diabetic patient eye imaging collection in their study [5]. They used local binary patterns for image feature extraction, naive bayes, and support vector machine algorithms to categorize patient data since medical data is expanding rapidly and has to be processed in order to forecast the specific disease based on symptoms. They obtained an accurate diabetic retinopathy detected or not prediction as an output by providing input in the form of patients' eye retina photographs, which aids in understanding the stage of diabetic retinopathy. In terms of accuracy, memory, and time, they compared the outcomes of naive bayes with the SVM method. The accuracy of the SVM method, which is higher than that of the Naive Bayes algorithm, and the time necessary for classification SVM is less than nave bayes, and nave bayes requires more memory than SVM.

Machine learning techniques were utilized in study [3] to predict the incidence of Diabetic Retinopathy. Of the numerous available classification methods, they utilized four: Naive Bayes, Decision Tree, K-Nearest Neighbor, and Support Vector Machine. Each algorithm has benefits and disadvantages that are particular to the type of application. Nonetheless, the findings showed that among the others, support vector machine had the greatest accuracy, closely followed by KNN. For the test data set with a few specified parameters, the performance of the other algorithms was average. The technique had a few restrictions in terms of the quantity of attributes employed and how the data were represented.

In the past, data mining techniques were liberally utilized in the field of medical diagnosis and prognosis, as described in article [4]. This study focuses mostly on feature relevance and classification strategies for properly categorizing retinal diseases based on characteristics derived from retinal images using image processing techniques. A rigorous evaluation of feature relevance and classification techniques was also undertaken to support the claim that C4.5 and the Random tree algorithm are the best accurate classifiers for predicting illness in the retinal image dataset.

They presented an algorithm for predicting diabetic retinopathy development in publication [6]. deep learning method, employing color fundus pictures taken in a single visit from a diabetic retinopathy patient as input. The suggested deep learning models were created to forecast future development in diabetic retinopathy, which is characterized as a two-step deterioration on the Early Therapy Diabetic Retinopathy Scale. Diabetic Retinopathy Severity Scale, and were trained against severity scores measured six, twelve, and twenty-four months after the baseline visit by diabetic retinopathy, well-trained, human reading center graders..

The performance of one of these models yielded an area under the curve of 0.79. Importantly, their findings emphasize the significance of the predictive signal found in the peripheral retinal fields, which are not frequently gathered for DR

evaluations. These findings suggest that it is possible to anticipate future DR development. With further research on larger and more diversified picture datasets, an algorithm like this might enable early diagnosis and referral to a retina expert for more regular monitoring, as well as early intervention consideration. Furthermore, it may boost patient recruitment for diabetic retinopathy clinical studies.

An artificial intelligence-based diabetic retinopathy solution that may aid the doctor with fundus picture interpretation and therefore swiftly inform the next stages in the patient's care is presented in article [7]. In addition, doctors may devote more time to patients who require it. New healthcare technologies place a premium on decreasing visits to eye specialists, lowering total treatment costs, and increasing the number of patients seen by each practitioner. Artificial intelligence can assist health care professionals in reaching their objectives. Whilst technology can help in the health care industry, it should not be used to replace clinicians at this time. Artificial intelligence advancements are bringing new opportunities for running diabetic retinopathy diagnosis and grading algorithms.

3. OVERVIEW OF THESYSTEM

3.1 Existing System

https://quillbot.com1. Visual acuity test: This test using an eye chart to assess how well a person sees at various distances (i.e., visual activity). 2. Pupil dilation: The eye doctor inserts drop into the eye to dilate the pupil. This enables the patient to see more of the retina and later examine for indicators of diabetic retinopathy. Vision may be obscured for some time after the test. 3. Ophthalmoscopy or fundus photography: Ophthalmoscopy is a retinal examination performed by an eye care expert. The first method is to gaze through a slit lamp biomicroscope with a special magnifying lens that offers a small view of the patient's retina, or to wear a headset with a bright light and stare through a special magnifying glass to acquire a broad view of the retina of the eye. A handheld ophthalmoscope cannot rule out serious and curable diabetic retinopathy disease. Fundus photography, in general, catches far wider sections of the fundus and offers the benefit of visual recording for future reference, as well as allowing the image to be inspected by a professional at a different place and/or time. 4. Fundus Fluorescein Angiography (FFA): This is an imaging method that uses fluorescein dye to demonstrate staining, leakage, or non-perfusion of the retinal and choroidal vasculature. [1] 5. Optical Coherence Tomography (OCT): Like ultrasound, this is an optical imaging method based on interference. It generates cross-sectional pictures of the retina that may be used to quantify the thickness of the retina and resolve its primary layers of the eye, allowing swelling to be observed. [2].

3.1.1 Disadvantages of Existing System

- Physicians are currently manually assessing individuals for diabetic retinopathy. This is a time-consuming procedure. As a result, therapy is delayed, potentially worsening the issue. Using retina pictures, this trained model can forecast illness. This will take a significant amount of time. The picture data set will be gathered, and the model will be trained with it. The neural network algorithm is a type of algorithm. This model has been trained so that the output is separated into five classes. As a result, the supplied image will belong to one of these classes. The key constraint here is a lack of resources. A large amount of data is required to train the model. Only with the right dataset can we train the model. The data collection should consist of high-resolution retinal pictures. The hardware needed is another constraint of this project. The model needs a large amount of RAM. To train the model, we need to acquire high-resolution photos from medical institutes or other sources. This is also a time-consuming operation. The photographs gathered should also be carefully organized. This is yet another constraint.

3.2 Proposed System

In this research, we are developing an AI-based model for detecting diabetic retinopathy using color fundus photography as the input. The model developed for this study will categorize the condition into five stages, from which clinicians will be able to give therapy. No Diabetics Retinopathy, Mild Diabetics Retinopathy, Moderate Diabetics Retinopathy, Severe Diabetics Retinopathy, and Proliferative Diabetics Retinopathy are the phases. Using an image processing approach, this model may display changes from several fundus camera photos. To process fundus pictures as rapidly and precisely as manual screening, the model employs new machine learning technologies. Our technology is built around Convolutional Neural Networks, which extract diagnostic characteristics using an algorithm that has been trained to categories pictures across labels. Image normalization, rescaling to a standard size, picture augmentation, and other image pre-processing operations are performed to accommodate diverse fundus cameras..

Advantages of Proposed System

✓ Proposed system is accurate in detecting diabetic diseases and classification.

✓ Accuracy of the proposed model is more accurate than existing methods.

3.3 Proposed System Design

In this project work, I used five modules and each module has own functions, such as:

1. Dataset
2. Preprocessing
3. Segmentation
4. Classification

3.3.1 *Dataset*

In this paper, we use two separate datasets. The first was obtained from a hospital, while the rest were obtained from Google Images.

3.3.2 *Image segmentation*

• Image Improvement

Picture improvement techniques increase an image's properties such as boosting its contrast and brightness, lowering its noise content, or sharpening the features. This just improves the image and shows the same information in more detail.

• Image Restoring

Image restoration, like image enhancement, improves image qualities, but all operations are primarily based on known, measured, or degradations of the original image. Image restoration is used to restore images with problems such as geometric distortion, improper focus, repetitive noise, and camera motion. It is used to adjust for known degradations in photos.

• Image Processing

Image analysis operations generate numerical or graphical data based on the properties of the original picture; they divide the image into objects and then categorise them based on the image statistic. In machine vision applications, frequent processes include the extraction and description of scene and picture characteristics, automated measurements, and object categorization image analysis.

• Image Reduction

Image compression and decompression minimize the data content required to describe the image most images have a lot of redundant information, compression removes all the redundancies since the size is reduced, so it can be stored or transferred more efficiently. When the compressed picture is presented, it is decompressed. Lossless compression maintains the precise data in the original image, whereas loss compression does not reflect the original image but provides good compression.

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3.3.3 Segmentation

This method relies heavily on segmentation. It entails segmenting an image input to facilitate image analysis. Segments are collections of pixels that represent things or sections of objects in a picture. Image segmentation divides pixels into bigger components, removing the requirement for convolutional neural networks to treat individual pixels as units of observation. Image segmentation using CNN entails providing picture segments as input. to a convolutional neural network. The convolutional layers divide the picture into pixels to identify context, including object placement.

3.3.4 *Classification:*

The suggested CNN structure consists of numerous layers, beginning with the input layer, which contains the augmented pictures from the previous pre-processing phase, and progressing through the convolution layers and their activation functions, which are utilized in feature selection and down-sampling. A dropout layer is used to prevent overfitting, followed by a fully connected layer and a softmax layer to anticipate the output, and lastly a classification layer that outputs the predicted class..

4 Architecture

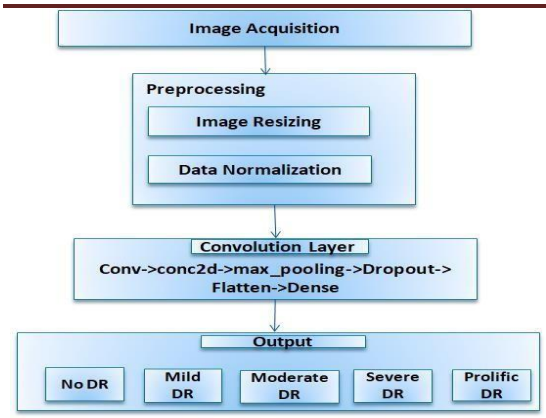
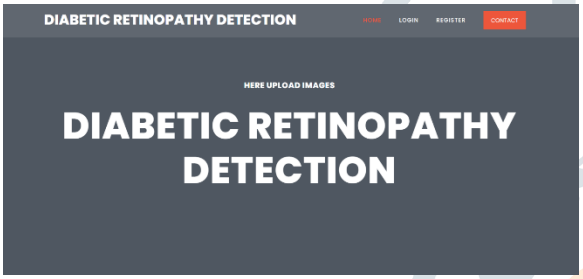


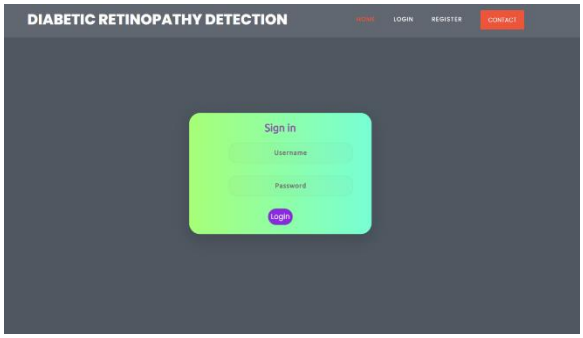
Fig 1: Frame work of skin disease detection

5 RESULTS SCREEN SHOTS

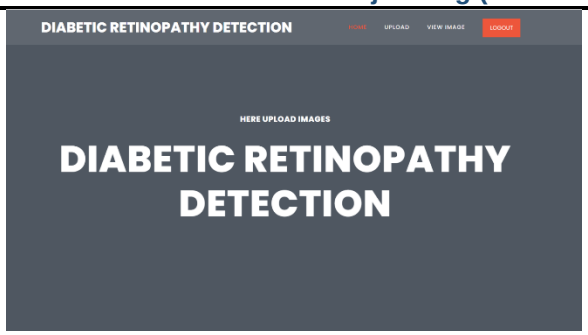


Home page with register login tabs and contact page

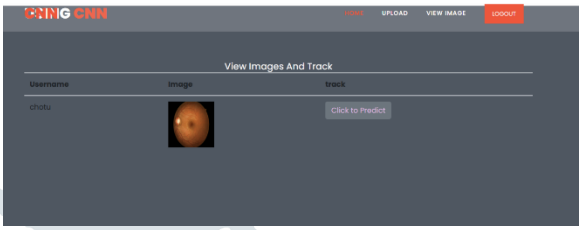
Registration Page for user to register with application with valid details



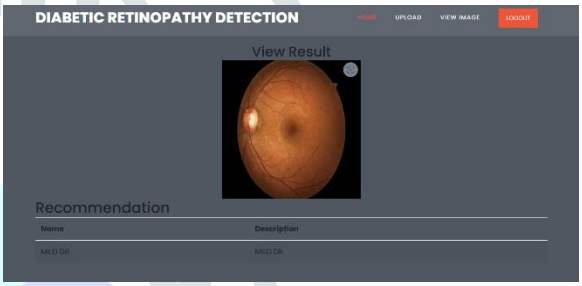
Login : login with valid user name and password



User home page to upload file and view image



View uploaded image



Diabetic prediction results

- The accuracy after training on 800 images with an epoch = 1, is 16%. In figure 5.4.1 the prediction of image was not properly done.
- The image used for testing belonged to class labelled as 4, but the model predicted it as class 0.
- The accuracy increased to 25% after the epochs were increased to 50. The prediction of the test image moved to class 2.
- The image is predicted properly. The test image belonged to class 4 and the model predicted it correctly.

6. CONCLUSION

✓ Detecting the condition is now a time-consuming and laborious process that necessitates a qualified doctor examining and evaluating digital color fundus pictures of the retina. We are building an artificial intelligence-based diagnostic tool to identify and assess the level of Diabetic Retinopathy illness based on fundus pictures of the eye retina in the proposed system. Using an image preprocessing approach, this program will allow you to observe variations from several fundus camera photos. It employs one of the most recent machine learning techniques to analyze fundus pictures rapidly and reliably. It shortens

the time required for the entire operation. The potential benefit of employing our trained CNN is that it can categorize hundreds of photos per minute, allowing it to be utilized in a variety of applications. When a fresh image is acquired in the real-time world. The trained CNN allows for a swift diagnosis and immediate treatment to the patient. This variant can also be used with a fundus camera.

Future Enhancement

- ✓ This research study exclusively looked at diabetic people. Readmission In the Indian healthcare system, prediction models for various critical health ailments and diseases such as heart disease, renal disease, and so on are required. Readmissions, both intentional and unexpected, must be included in future investigations. Other important elements in medical records include family history (to discover inherited information about the patient), emotional status (depression or other mental condition), socioeconomic status, and lifestyle habits (exercise or yoga), smoking status, and season of birth. Readmission data must be gathered and evaluated. It will be fascinating to conduct a more thorough examination of additional variables in the gathered dataset and investigate their significance to predicting the probability of readmission.

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