Diabetic Retinopathy Eye Disease Detection Using Machine Learning

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Abstract

INTRODUCTION: Diabetic retinopathy is the name given to diabetes problems that harm the eyes. Its root cause is damage to the blood capillaries in the tissue that is light-sensitive in the rear of the eye. Over time, having excessive blood sugar may cause to the tiny blood capillaries that nourish the retina to become blocked, severing the retina's blood circulation. As a result, the eye tries to develop new blood arteries.

OBJECTIVES: The objective of this research is to analyse and compare various algorithms based on their performance and efficiency in predicting Diabetic Retinopathy.

METHODS: To achieve this, an experimental model was developed to predict Diabetic Retinopathy at early stage.

RESULTS: The results provide valuable insights into the effectiveness and scalability of these algorithms. The findings of this study contribute to the understanding of various algorithm selection and its impact on the overall performance of models.

CONCLUSION: The findings of this study contribute to the understanding of multiple algorithm selection and its impact on the overall performance of models' accuracy. By applying these algorithms, we can predict disease at early stage such that it can be cured efficiently before it goes worse.

Keywords: Eye Disease Detection, Machine Learning, K-Nearest Neighbours, Support Vector Machine, Convolutional Neural Network

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1. Introduction

In persons with diabetes, a disease known as diabetic retinopathy can result in visual loss and eventual blindness. It impacts the retina’s blood vessels.

Figure 1. Diabetic Retinopathy and Normal Eye Retina

A blood sugar level that is consistently high can harm these blood vessels over time in two stages:

1.1 Pre-proliferative retinopathy

This stage of diabetic retinopathy occurs when blood’s capillary system present at eye retina are injured due to excessive sugar levels. At this point, the retina starts swelling as a result of the injured blood vessels leaking fluid and blood into the eye, causes more severe and pervasive blood vessel alterations, including more extensive eye haemorrhage.

1.2 Proliferative retinopathy

The blocked damaged blood capillaries in eye’s retina cause the development of abnormal new blood capillaries, which is the advanced stage of diabetic retinopathy. The retina may become severely swollen and scarred as a result of these new blood vessels, which could impair vision. “Machine learning” is that branch of AI (Artificial Intelligence) that lets computers in learning from various raw pieces of information, see repeats, and generate judgements.

Machine learning can evaluate huge datasets of retinal images and precisely identify the symptoms of diabetic retinopathy, making it beneficial in the detection of the condition. The detection and monitoring of diabetic retinopathy could become more accurate and efficient due to machine learning, which could result in better outcomes for people with this condition. In this research paper demonstrate the potential of machine learning algorithm like CNN (“Convolutional Neural Network”), KNN (“K-Nearest Neighbors”), SVM (“Support Vector Machine”) for the detection of diabetic retinopathy.

2. Literature Review

Gulshan Varun, Peng lily et al. [1], in the study shows the evaluation a CNN model used a large dataset to train the model of retinal fundus images. According to the study, classic machine learning models for Diabetic Retinopathy classification, such SVM and KNN, can be outperformed by deep learning models.

R Revaty, B S Nithiya, et al. [2], in the study the authors suggest a method for classifying retinal images into various degrees of diabetic retinopathy by using random forest and image processing methods. The paper presents a promising approach for detecting diabetic retinopathy by applying machine learning methods. However, there are some limitations that need to be addressed in subsequent research, including the relatively small dataset. A short dataset may lead to overfitting and prevent the model from generalising to new data.

Just like these many studies have been done to assess how well various machine learning algorithms perform for Diabetic Retinopathy categorization those are depicted in the table shown below:

<table>
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<th>Sr. No.</th>
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Apoorva Hegde, K R Sumana

Support Vector Machine, k_nearest neighbours, random forests use different machine learning algorithms, suggests that combining various algorithms could enhance the effectiveness of detecting diabetic retinopathy overall.

N. Ramesh and S. Viswanath

SVM (Support Vector Machine), k-NN (k-Nearest Neighbours) and CNN (Convolutional Neural Network) gives a summary of the many machine learning methods used to diagnose diabetic retinopathy, also emphasised the significance of feature selection and data pre-processing.

S. K. Singh and S. Kumar

SVM (Support Vector Machine), k-NN (k-Nearest Neighbours) and decision trees use different machine learning algorithms, suggests that combining various algorithms could enhance the effectiveness of detecting diabetic retinopathy overall.

7 “Diabetic retinopathy detection using Gabor filter and support vector machine, 2016”
V. S. Senthil Kumar and S. Karpagam

Gabor filter-based texture features and Support Vector Machine (SVM) gives a summary of the many machine learning methods used to diagnose diabetic retinopathy, also emphasised the significance of feature selection and data pre-processing.

8 “Classification of diabetic retinopathy and normal retinopathy using CNN (Convolutional Neural Network) and SVM (Support Vector Machine), 2019”
Dinial Utami Nurul Qomarih, Handayani Tjandra et al.

The method described in this paper— which combines CNN and SVM is a captivating approach for categorising retinal pictures, and the results are encouraging.

Liu Y, Chen Q et al.

A CNN using ultra-widefield and mydriatic pictures is shown in the study as a useful method for Diabetic Retinopathy detection in fundus images. The findings are encouraging and may have effects on the early detection and management of Diabetic Retinopathy.

10 “Detection of diabetic retinopathy using machine learning, correlation analysis, and ROI selection techniques, 2020”
Nagraj R. Acharya et al.

The random forest method showed the highest accuracy in Diabetic Retinopathy detection in fundus images, which is an encouraging outcome.

Machine learning is that branch of AI (Artificial Intelligence) that lets computers in learning from various raw pieces of information, see repeats, and generate judgements [7-9]. Machine learning can evaluate huge datasets of various other domains in addition to retinal images like hunting exoplanets, various other prediction and classification-based systems [10-19].
3. Proposed Model

A flowchart illustrating the approach is provided here to use machine learning to detect diabetic retinopathy. In the first phase, retinal images are collected into a database and put through pre-processing procedures to improve their quality by removing noise. A model that can distinguish between normal and abnormal diabetic retinopathy (both moderate and severe) can then be developed using machine learning using this well selected dataset.

4. Results

Figure 3. The retina images preprocessing methods

Figure 4. Sample images of the (a) original image and (b) the preprocessing image

We used a publicly available dataset of fundus images collected of diabetes individuals for our study. The fundus images in the dataset were split into training and testing sets. The training set was then used to train CNN models.
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6. Conclusion

In this paper, we show the use of CNN for the detection and categorization of diabetic retinopathy. CNN showed the best performance among Machine Learning techniques.

Our study demonstrates that machine learning models can help with the early diagnosis and treatment of diabetic retinopathy, which can lower the risk of blindness in diabetes patients.

The results of our study demonstrate the significant success of the suggested strategy and its scope in real-world medical settings.

References


