

Retinal Disease Detection Using Deep CNN

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Abstract

Age-related macular degeneration, glaucoma, and diabetic retinopathy are the three main causes of blindness in the globe. To avoid visual loss, early identification and treatment of these disorders are essential. The goal of this research is to create an automated method for detecting retinal diseases by analyzing retinal fundus pictures with machine learning techniques. Python and the Tkinter package for the graphical user interface are used in the construction of the system. High accuracy is attained by the trained ResNet model in differentiating between normal and aberrant retinal pictures. The model provides disease prediction and classification results for a given input fundus image through an intuitive and user-friendly interface. By delivering rapid and automated screening, this system plays a crucial role in the early diagnosis of retinal abnormalities. Early detection is vital for initiating timely treatment, which can significantly reduce the risk of vision impairment and other complications. This advanced technology supports healthcare professionals in making informed decisions and offers a reliable tool for routine screenings, ultimately enhancing patient outcomes and contributing to the prevention of severe vision loss.

Keywords: RESNET, convolutional neural networks, retinal disease detection, fundus images, healthcare, vision impairment, retinal abnormalities, medical imaging, disease classification, patient outcomes.

INTRODUCTION

Retinal diseases such as diabetic retinopathy, glaucoma, and age-related macular degeneration are the leading causes of blindness worldwide. As the population ages and diabetes rates increase, the number of people affected by retinal diseases continues to increase. Early detection and treatment of retinal abnormalities are critical to preventing permanent vision loss.

However, manual review of retinal images by ophthalmologists is time-consuming and prone to human error. For abnormal images, the model also divides the disease into several groups based on the type of abnormality observed: diabetic retinopathy, glaucoma, macular degeneration, etc. Users simply upload fundus images through the interface and the model displays the prediction and distribution of

disease information. The patient needs further examination and treatment. This device, which provides fast and accurate automatic analysis of retinal images, will help in the early diagnosis and intervention of retinal diseases and thus help prevent blindness. It paves the way for automatic analysis. Deep learning neural networks can be trained to extract important details and patterns from retinal images to accurately diagnose abnormalities and diseases. Data processing techniques are used to connect the size and diversity of data sets. A previously published, otherwise nearly identical, approach that does not use deep learning is greatly outperformed by a deep learning improved algorithm for the automated

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identification of DR [1]. Applying a deep learning-based automated assessment of AMD from fundus images can produce results that are similar to human performance levels [2].

LITERATURE REVIEW

Analysis of facial images using machine learning and computer vision techniques has been an area of research for the last two decades. The results of deep learning are very good for medical image analysis and diagnostic studies. Chen *et al.* showed that deep convolutional neural networks (CNN) can distinguish normal retina images from diabetic retinopathy images very well [3].

Gargeya and Leng showed that deep learning outperformed traditional machine learning techniques in diagnosing diabetic retinopathy and macular edema from retinal images [4–9]. Scoring System Deep CNN with near-expert level scoring accuracy for Cataract detection from light source images using transformation learning by optimizing the VGG Net architecture before training on natural images 2018. This approach leverages advanced convolutional neural networks to enhance the accuracy and efficiency of cataract diagnosis from diverse image datasets. Their achievements are delicate and unique. They (2018) used CNN in combination with a regression model to predict glaucoma incidence and showed good discrimination ability. Recently expanded on this approach [9].

Trained a deep learning method on a large dataset of retinal fundus images to classify images into orientation-guaranteed and non-orientation-guaranteed groups. Their algorithms achieved high sensitivity and specificity in the diagnosis of diabetic retinopathy and macular edema. Our project aims to develop diagnostic tools for eye diseases by training deep residual neural networks on a large dataset of normal and diseased retinal images [4].

SELECTION OF RESEARCH PROBLEM

There is an urgent need to develop electronic devices that can quickly and legally analyze retinal images to assist doctors in the early detection and intervention of diseases. However, existing methods may not have the power and accuracy needed to be used for treatment, especially in isolating diseases in bones. Therefore, the research problem focuses on creating a new automatic retinal disease detection system that uses machine learning algorithms such as deep neural networks to improve evaluation control efficiency and accuracy.

These research questions highlight the need for accurate and precise diagnosis of retinal diseases, including diabetic retinopathy, glaucoma, and age-related macular degeneration. Despite advances in technology, dictionary interpretation of retinal fundus images still requires time and detail, causing delays in diagnosis and treatment. This research aims to fill the gap in current diagnostic approaches by providing a reliable and user-friendly tool for early detection and classification of retinal diseases, ultimately improving patient outcomes in ophthalmic care [5].

METHODOLOGY

The first important step is to collect optical data covering normal and pathological conditions. The images will be collected from publicly available information and through collaboration with optical centers. Only high-quality images were retained after manual analysis. The image is then subjected to pre-processing, which includes conversion to long exposure, contrast normalization, color normalization, and noise removal. Data enhancement techniques such as translation, rotation, scaling and shifting will be applied programmatically to generate more data from existing images. This comprehensive and preliminary data will be used to train machine learning models. Adaptive learning will be implemented by initializing the network using weights from the ResNet model before training on the ImageNet dataset. This makes designs universal features learned from natural images.

The model is then modified and copied over selected data of retinal images. In this way, the model is fine-tuned so that it can learn certain characters and patterns unique to the fundus image. The model

will be trained end-to-end using stochastic gradient descent on unemployment, which compares predictions to actuals.

Test Equipment

The validation process will be used to tune hyperparameters and model architecture. Final model testing will be conducted on a blind test to obtain an unbiased estimate of the model's performance. Measurements such as accuracy, sensitivity, specificity, and AUC-ROC curve will be used to evaluate model performance [6].

The results of the testing will determine whether the model is robust and ready for clinical use. It will allow easy upload of test images, display of predictive models and distribution of information for doctors. Options will be provided to repeat the prediction and process the rendering of the image. After testing, the model and connection are packaged into a functional application and sent to doctors' systems for evaluation and validation. If initial results are not sufficient to meet clinical standards, the method can be improved and performance standards improved. The model can be trained multiple times using larger datasets to increase accuracy.

Different network architectures such as DenseNets and Vision Transformers can be examined and compared with ResNet. Combination models can be used to improve performance by combining multiple models. The model can also be updated by adding new training data to include new viruses and image features. Multivariate learning can be used with joint model training to perform related tasks such as classifying anatomical structures and classifying diseases. Optimization and improvement of this process will help improve the sensitivity and specificity of the model. Data and tools measure the data set for effective use. Acceptance of different materials not used in training is important to ensure consistency between scenarios [7].

The model will evaluate parameters such as patient management, physician performance, integration and ease of use through medical care. Feedback from opticians and technologists will be incorporated to address limitations and optimize the system. Its effectiveness and safety will be proven through rigorous testing and approved by regulatory authorities. Only after all real-world testing and clinical applications will AI systems be validated and widely used to help ophthalmologists identify and diagnose eye diseases.

Datasets

The first step in creating a diagnostic system for dermatological diseases is gathering data. This can be done in a number of ways: by gathering data from specialized clinics and hospitals, by selecting data at random from electronic websites on the Internet, or by visiting official websites and approved repositories that specialize in providing data sets for researchers and students.

The Kaggle diabetic retinopathy detection dataset: This dataset comprises retinal fundus images with annotations for diabetic retinopathy severity levels, allowing for the development and evaluation of diabetic retinopathy detection algorithms.

The DRIONS-DB dataset: This dataset provides retinal fundus images annotated for glaucoma, allowing for the training and evaluation of glaucoma detection models.

SYSTEM ARCHITECTURE

Figure 1 shows the system architecture of the automatic retinal disease detection system which consists of various communication modules. First, the data acquisition and preprocessing model collects retinal fundus images from different sources and normalizes them for training. Images are pre-processed including resizing and normalization to improve dataset quality. Through repeated training, the network learns to classify images as normal or abnormal and distinguish certain diseases such as diabetic

retinopathy, glaucoma, or macular degeneration. Evaluate model performance using valid data to ensure accuracy and generality. This module guides the user through every step and shows the results clearly. This model analyzes image features and produces predictions indicating whether the image is healthy or infected and specific disease if present [8].

Summary

Real-time eye disease detection systems, utilizing ResNet architecture, are poised to revolutionize telemedicine by providing timely and accurate diagnosis remotely. These systems are designed with lightweight models optimized for deployment on mobile devices, ensuring minimal latency and efficient resource utilization. Implementation involves integrating real-time image processing and classification algorithms with telemedicine platforms for seamless remote consultation.

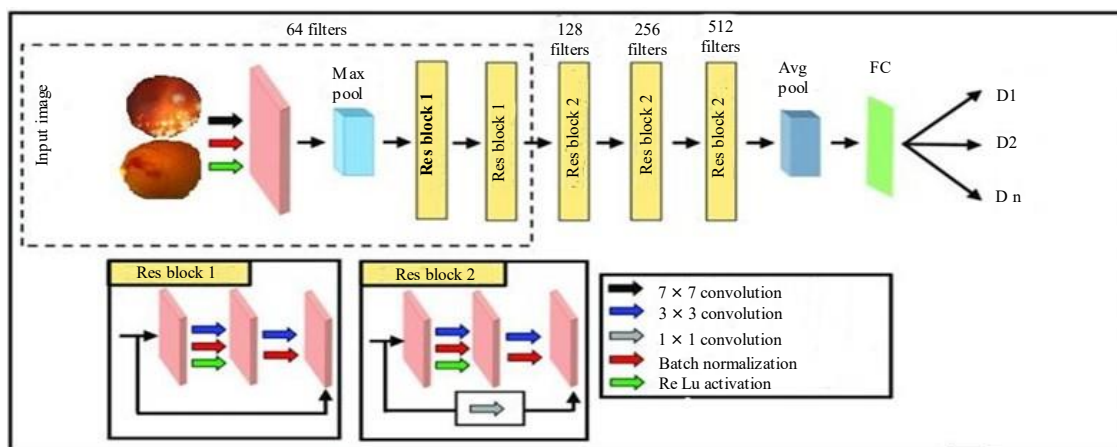


Figure 1. System architecture of the automated retinal disease detection system, illustrating the communication modules for data acquisition, preprocessing, image classification, and result presentation.

Its goal is to develop an automatic eye disease detection system that uses machine learning algorithms, specifically deep neural networks (ResNet), to identify retinal images. Leveraging Python and Tkinter modules, the system provides medical professionals with a user-friendly interface to upload images and receive rapid diagnosis and classification. Large volumes of retinal imaging data are used to train the ResNet model, which shows accuracy in identifying aberrant pictures and categorizing conditions including glaucoma, macular degeneration, and diabetic retinopathy. Using these methods has the potential to improve diagnosis and access to eye care. Through the use of diagnostic techniques, it facilitates early intervention and personalized treatment strategies, ultimately reducing the burden of retinal diseases and improving patient outcomes [9, 10].

CONCLUSION

Retinal diseases like diabetic retinopathy, glaucoma and macular degeneration are leading causes of preventable vision impairment worldwide. Screening and early detection of these diseases through examination of retinal fundus images is crucial for timely treatment and intervention. However, manual evaluation of these images is tedious, time-consuming and prone to human error, making computer-aided diagnosis highly desirable.

This project aimed to develop an automated retinal disease screening system using deep machine learning techniques to analyze fundus photographs. A deep residual neural network model was trained on a large curated dataset of normal and diseased retinal images. The model achieved high accuracy in classifying retinal images as normal or abnormal, and could further detect the specific disease type. The user-friendly graphical interface developed allows ophthalmologists to quickly screen patients by uploading fundus images and receiving automated prediction reports.

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