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Detection Of Glaucoma Eye Disease Using Retinal Fundus Images

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Abstract: Glaucoma is a term used to describe the cumulative loss of retinal cells in the optic nerve or permanent vision loss due to optic neuropathy. Glaucoma is a disease of the human eye. This disease is considered an irreversible disease that causes deterioration of vision. They have no early warning signs of glaucoma. You may not notice a change in your vision because the effect is so subtle. Many deep learning (DL) models have been developed to improve the diagnosis of glaucoma. Therefore, we present an architecture for accurate glaucoma detection based on deep learning using convolutional neural networks (CNN). The distinction between glaucoma and non-glaucoma patterns can be made using CNN. CNN provides a hierarchical structure for image differentiation. Using the current method, the disease is detected. It determines whether the patient has glaucoma or not, the relationship between the eye and the disc. Improved diagnosis by combining image data generator techniques to augment data. The results show that the proposed model outperforms existing algorithms, achieving 98.47% accuracy.

Keywords: Feature Extraction, Machine Learning, CNN, Image Data Generator,Glaucoma,keras,streamlit

I. INTRODUCTION

Glaucoma is a group of eye diseases that cause damage to the optic nerve (or retina) and loss of vision. Open-angle glaucoma is often unnoticed as it develops slowly over time and is painless. Peripheral vision first decreases, then central vision, and if left untreated, blindness. Angular glaucoma can develop slowly or suddenly. The most common types are open-angle glaucoma (wide-angle, chronic simple), in which the drainage angle remains open to fluid in the eye, closed-angle glaucoma (narrow-angle, acute-occlusive), and normal-tension glaucoma. Sudden eye pain, blurred vision, medium-sized pupils, red eyes, and nausea may occur. Loss of vision from glaucoma is permanent once it occurs. Eyes affected by glaucoma are called glaucomatous. Risk factors for glaucoma include increasing age, high pressure in the eye, family history of glaucoma, and use of steroid medications. For eye pressure, a value of 21 mmHg or 2.8 kPa above atmospheric pressure (760 mmHg) is used, with higher pressures posing a greater risk. However, some can have high pressure for years and never experience any damage. Conversely, normal pressure can cause damage to the optic nerve with normal pressure, known as glaucoma. The mechanism of open-angle glaucoma is thought to be the slow release of humor through the trabecular tissue, while in angle-closure glaucoma, the iris obstructs the trabecular tissue. Dilated eye examination is usually used for diagnosis. Often, the optic nerve shows an amount of cupping that is abnormal.

II. LITERATURE SURVEY

In [1] Glaucoma Detection using Convolutional Neural Network: Aniket Patil, Risha Shetty, Sakshi Jain, Sejal D'mello have proposed a Convolutional Neural Network (CNN) system for early detection of Glaucoma. Initially, eye images are augmented to generate data for Deep learning. The eye images are then pre- processed to remove noise using Gaussian Blur technique and make the image suitable for further processing. The system is trained using the pre-processed images and when new input images are given to the system it classifies them as normal eye or glaucoma eye based on the features extracted during training.

In [2] Glaucoma-Deep: Detection of Glaucoma Eye Disease on Retinal Fundus Images using Deep Learning : Abbas Q Qaisar, Riyadh have proposed convolutional neural network (CNN) unsupervised architecture was used to extract the features through multilayer from raw pixel intensities. Afterwards, the deep-belief network (DBN) model was used to select the most discriminative deep features based on the annotated training dataset. At last, the final decision is performed by s linear classifier to differentiate between glaucoma and non-glaucoma retinal fundus image.

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This proposed system is known as Glaucoma-Deep and tested on 1200 retinal images obtained from publically and privately available datasets. To evaluate the performance of Glaucoma-Deep system, the sensitivity (SE), specificity (SP), accuracy (ACC), and precision (PRC) statistical measures were utilized. Comparing to state-of-the-art systems, the Nodular-Deep system accomplished significant higher results. Consequently, the Glaucoma-Deep system can easily recognize the glaucoma eye disease to solve the problem of clinical experts during eye-screening process on large-scale environments.

In [3] Detection of Glaucoma Using Cup to Disc Ratio From Spectral Domain Optical Coherence Tomography Images :TEHMINA KHALIL , M. USMAN AKRAM , HINA RAJA , AMINA JAMEEL , IMRAN have proposed system, cup-to-disc-ratio has been computed considering internal layers of the retina using spectral-domain optical coherence tomography images. In the cupdiameter-calculation process, cup contour has been extracted from inner-limiting-membrane (ILM) layer. The paper introduces a new method to improve the precision of the ILM-layer extraction. It also employs a novel technique to refine contour of an ILM layer. The novel method has outperformed interpolation and Bezier curve fitting in term of outliers' removal and surface refinement. In the disc-diameter-calculation process, the retinal-pigment-epithelium (RPE) layer end points have been used to define disc margin. Prior to RPE-layer extraction, ILM-Layer removal has been done by an innovative strategy to locate and remove ILM-layer. Finally, precise RPE-layer extraction has been done based on the novel thickness-value (TV) estimation method. Furthermore, a new criterion for cup edges determination, based on the mean value of RPE-layer end points, is proposed. The proposed system has shown a clear precedence over its contemporary systems in terms of accuracy and handling of acute cases. Satisfactory results have been obtained when compared with the clinical results

In [4] Dual Machine-Learning System to Aid Glaucoma Diagnosis Using Disc and Cup Feature Extraction :JAVIER CIVIT-MASOT , MANUEL J. DOMÍNGUEZ-MORALES , SATURNINO VICENTE-DÍAZ , AND ANTON CIVIT. The classic techniques to detect it have undergone a great change since the intrusion of machine learning techniques into the processing of eye fundus images. Several works focus on training a convolutional neural network (CNN) by brute force, while others use segmentation and feature extraction techniques to detect glaucoma. In this work, a diagnostic aid tool to detect glaucoma using eye fundus images is developed, trained and tested. It consists of two subsystems that are independently trained and tested, combining their results to improve glaucoma detection. The first subsystem applies machine learning and segmentation techniques to detect optic disc and cup independently, combine them and extract their physical and positional features. The second one applies transfer learning techniques to a pre-trained CNN to detect glaucoma through the analysis of the complete eye fundus images. The results of both systems are combined to discriminate positive cases of glaucoma and improve final detection. The results show that this system achieves a higher classification rate than previous works. The system also provides information on the basis for the proposed diagnosis suggestion that can help the ophthalmologist to accept or modify it.

III. SCOPE AND METHODOLOGY

AIM OF THE PROJECT

The aim of the project is to develop an accurate glaucoma detection system using deep learning techniques, specifically convolutional neural networks (CNNs). This system aims to distinguish between glaucomatous and non-glaucomatous patterns in eye images. By leveraging the hierarchical structure of CNNs, the model can effectively differentiate between various features in the images related to glaucoma.The project also focuses on improving the diagnosis of glaucoma by incorporating image data augmentation techniques to increase the diversity and quantity of data available for training. This augmentation helps the model generalize better to unseen data and improves its ability to detect glaucoma accurately.

EXISTING SYSTEM

The existing system for glaucoma detection likely involves traditional methods such as manual examination by ophthalmologists, which may include tests like tonometry to measure intraocular pressure, visual field testing, and examination of the optic nerve.Additionally, there may be computer-aided diagnosis (CAD) systems that utilize image processing and machine learning techniques. These systems may analyze features extracted from retinal images using methods like edge detection, texture analysis, and optic disc segmentation. Machine learning algorithms such as support vector machines (SVM), decision trees, or logistic regression may then be employed to classify the images as either indicative of glaucoma or normal.However, these existing systems may have limitations in terms of accuracy and efficiency, as they rely on manually crafted features and may not fully leverage the complex patterns present in the data.Overall, while existing systems provide valuable diagnostic tools, there is room for improvement in terms of accuracy, efficiency, and automation, which the proposed deep learning-based system aims to address.

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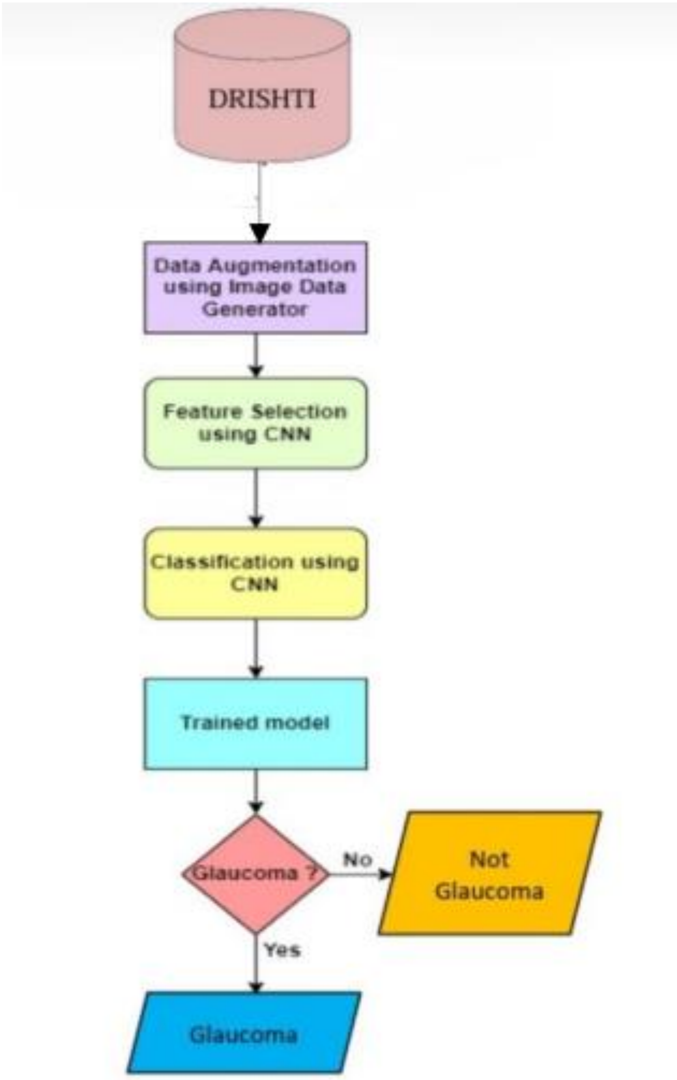
PROPOSED SYSTEM

The proposed glaucoma detection system is a comprehensive solution leveraging deep learning techniques, particularly Convolutional Neural Networks (CNNs), to accurately analyze retinal images for signs of glaucoma. Data Preprocessing and Augmentation Module system begins with a data preprocessing and augmentation module written in Python. This module is responsible for cleaning and preparing the input data before feeding it into the CNN model. It involves tasks such as resizing images, noise reduction, and handling missing values using OpenCV library.Data Mining and Augmentation: The system utilizes an open-source eye disease database to compile the dataset. To address limitations in dataset size and high variance, the system employs Keras ImageDataGenerator for data augmentation. This involves generating additional training data through random transformations like flips, crops, rotations, and scaling.Glaucoma Detection Model is the he core of the system is the glaucoma detection model built using Python, Keras, and TensorFlow. The model utilizes a CNN architecture to learn relevant features from preprocessed and augmented retinal images that differentiate between normal and glaucomatous eyes. The Keras ImageDataGenerator is used to apply random operations on the data, further expanding the dataset.Training and Evaluation, During training, the CNN learns to extract relevant features from the retinal images. The model is trained using a dedicated training dataset, and its performance is evaluated on a separate validation set to prevent overfitting. Metrics like accuracy, sensitivity, specificity, and area under the ROC curve are used for evaluation.For Web Application Interface,A web application, likely built with Streamlit, provides the user interface for the system. Users can upload retinal images through this interface, and the application utilizes the saved CNN model to make predictions. The user receives the model's prediction indicating whether the eye is normal or has signs of glaucoma.

SYSTEM ARCHITECTURE



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The glaucoma detection system leverages deep learning for image analysis. It starts with a data preprocessing and augmentation module written in Python. Preparing data for further analysis through basic processing or pre-processing is called data pre-processing. This is a method for converting dirty data into a clean data set. This term refers to the changes made to our data before it is fed to the algorithm. It can also be used to represent an initial or preliminary processing step that requires multiple steps to prepare data. Convert dirty data to clean data. Before the technique is used, it has been processed to check for noisy data, missing values, and other anomalies, creating unstructured data that can be interpreted. It is also an important step in data mining due to the difficulty of managing raw data. Data mining and machine learning should not be used without assessing their quality. display information. Data from an open source eye disease database was used to search and compile the database for the project. Three databases have fundus images showing glaucoma . Data mining is a feature offered by the Keras deep learning neural network library. We generate our data using the ImageDataGenerator class. Among other methods, we use zoom, straighten, channel shift, rotate, size and height shift. More image data is generated after multiplication data is used This module likely uses OpenCV for pre-processing tasks like resizing or noise reduction.

To address limitations in the dataset size and high variance, it employs Keras ImageDataGenerator to artificially expand the training data through random transformations like flips, crops, and rotations.The core of the system is the glaucoma detection model, also built using Python. This model utilizes a Convolutional Neural Network (CNN) architecture implemented with Keras on top of TensorFlow. The Keras ImageDataGenerator takes the original data input and transforms it randomly before producing an output that contains only the newly transformed data. To extend the usability of our model, additional data is added using the Keras ImageDataGenerator module. It uses an image data generator to perform random operations on the data, such as data multiplication, translation, rotation, and scaling. and vertical lines.

In the field of real-time data generation, Keras ImageDataGenerator is used to generate data clusters from tensor images. We can use the ImageDataGenerator by passing the relevant parameters and required input to the size class. The Image data generator class has several methods, including:stream from directory - This function generates duplicate data based on the directory path.To apply the image transformation to the values given as arguments, see the transformation used and get the parameters to transform the variable with x.Fit takes as input x, seed without default value, cycle (number of steps to be performed), and value for reinforcement. Data synthesis was adapted using this. method for certain data samples

Using feature extraction for image data, salient elements of an image are represented as small feature vectors. This has previously been done using special, feature extraction, feature detection, and feature matching algorithms. The flexibility of deep learning to take raw image data as input and undergo feature extraction procedures makes it a popular tool for image and video analysis today. Any computer vision application that uses image registration, object recognition, or classification must accurately represent image features regardless of the approach. This representation can be implicit or implicit in the initial layer of the deep network.One type of supervised machine learning technique involves grouping classified data into classes using one or more factors. Classification prediction models use data or observations as training input to classify new observations into groups or classes.During training, the CNN learns to extract relevant features from the preprocessed and augmented retinal images that differentiate between normal and glaucomatous eyes. The model is trained using a dedicated training dataset and its performance is evaluated on a separate validation set after each training epoch to prevent overfitting. Finally, the trained model is saved for future use.A web application, likely built with Streamlit, provides the user interface. Users can upload retinal images through this interface, and the application utilizes the saved CNN model to make predictions. The user receives the model's prediction normal or glaucoma . This web application can potentially be deployed on a web server for wider accessibility.

IV. CONCLUSION

The Permanent blindness caused by complications of glaucoma associated optic nerve damage. Because of this method, the application of glaucoma diagnosis will be expanded medical image processing technology. The computer-generated results of this work will helpto improve clinical judgment in the diagnosis of glaucoma. Because it exists more normal stock images in the database, this algorithm can detect glaucoma the correct picture.

The proposed method uses an image data generator for data multiply The original image is multiplied due to reproduction and is a large data setprepared. The magnified image is then submitted for feature extraction using CNN. Theimages are classified using binary classification because they have two outputs. Recommended systemreach an accuracy of 98.47%, which is special in this area.In future research, we are going to apply convolutional neural networkDiagnoses various eye diseases including cataracts, retinal detachment and diabetesretinopathy.

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