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A Review on Role of AI in Ophthalmology

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ABSTRACT

Ophthalmology is the branch of medicine and surgery that deals with the diagnosis and treatments of disorders of the eye. The abnormalities in a human eye are detected through fundus images captured through a fundus camera. The early diagnosis of glaucoma can prevent permanent loss of vision. The automatic detection of glaucoma by using a combination of image processing, artificial intelligence, and computer vision can help to prevent and detect this disease. The machine learning system described here can accurately differentiate between healthy and glaucomatous subjects.

Keywords: Convolution Neural Network, Optical Coherence Tomography

INTRODUCTION

Artificial intelligence (AI) assisted automated screening and analysis of the common diseases in ophthalmology. Through AI analysis of disease turn out to be more accurate and in advance. As a result, it saves you, humans, from leading to imaginative and prescient loss. The boom inside the wide variety of retinal sickness instances has produced an ever-growing demand for retinal picture readers. At the identical time, AI may additionally grow the performance of healthcare carriers using establishing the perfect and rapid prognosis of retinal sickness.AI in ophthalmology started with machine learning, which meant automatic behavior modification after exposure to several inputs. Deep learning is a subset of machine learning that uses convolutional neural networks to add decision-making capability. When incorporated into OCT, these features can help in the diagnosis of many anterior and posterior segment diseases.

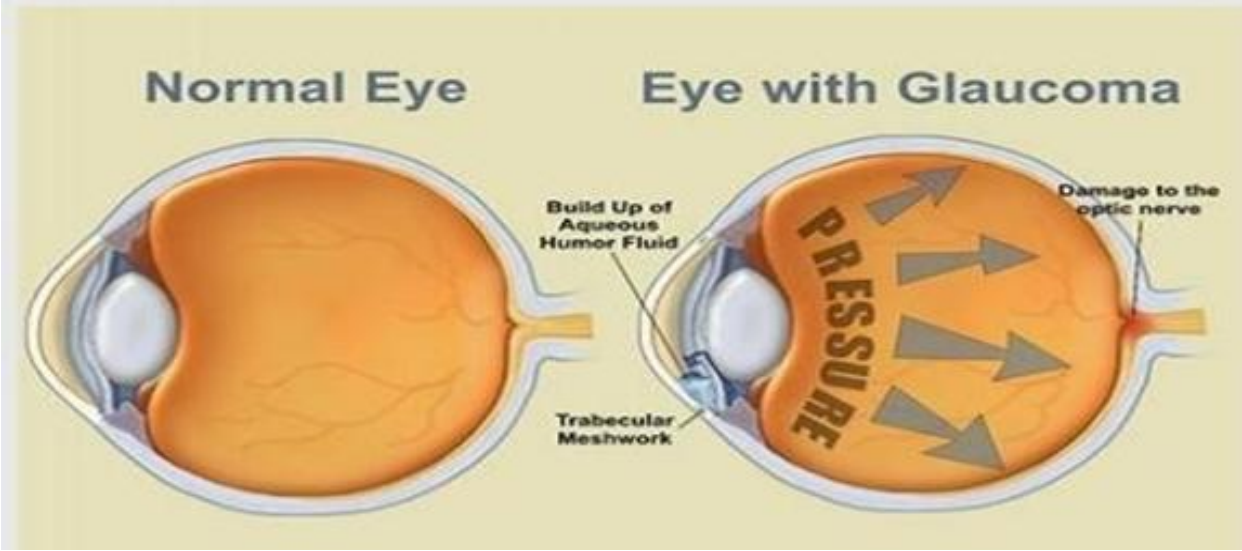

Fig (1) normal eye and glaucoma affected eye

LITERATURE SURVEY

[1] Xiangyu Chen et.al (2015) this paper explain to development of a deep learning architecture with a convolutional neural network for automated glaucomadiagnosis. Glaucoma and nonglaucoma patterns for diagnostic decisions can infer a hierarchical representation of images. There are six learned layers in the proposed deep learning architecture: four convolutional layers and two fully-connected layers.D2 dropout and data augmentation strategies are adopted to further boost the performance of glaucoma diagnosis. Extensive experiments are performed on the ORIGA and SCES datasets. The results show the area under the curve (AUC) of the receiver operating characteristic curve in glaucoma detection at 0.831 and 0.887 in the two databases, much better than state-of-the-art algorithms. The method could be used for glaucoma detection.

[2] U. Raghavendra et.al (2015) glaucoma detection is used to energy spectrum based method. Initially, the search window-based method is used to localized the optic disc. After Radon transformation (RT) is performed by using modified census transformation (MCT). To characterize the image by using a GIST descriptor. LSDA is used to further the normalization of features. In the private dataset, the system has claimed accuracy of 97% and at public dataset claimed accuracy of 93.62%.

[3] Muhammad Salman Haleem et.al (2016) This paper explain that optic disc and retinal imaging facilitate glaucoma detection however this approach requires guide publish- imaging changes that are time-consuming and subjective to image assessment human observers. Consequently, it is necessary to automate this process. In this work, we have first proposed a novel computer-aided approach for automatic glaucoma detection based on the regional image features model (RIFM) which can automatically perform classification between normal and glaucoma images based on regional information. A new accurate method of automatic optic disc localization; a new accurate method of optic disc segmentation; a new RIFM on the extraction of both geometric and non-geometric properties from different regions of the optic disc and its surroundings for classification between normal and glaucoma images; these are includes in this paper.

[4] Julian Zilly et.al (2016) This paper explains automatic OC and OD segmentation based on CNN. This method is used entropy sampling for selecting sampling and it should be better than uniform sampling. To design a learning system of convolutional filters the selected sampling points are used. The extracted OC and OD are used for CDR calculation which can be further used for glaucoma diagnosis.

[5] Gao Huang et.al (2017) introduces direct connections betweentwolayers with the same feature-map size. They scale naturally to hundreds of layers while exhibiting no optimization difficulties. In these experiments,densenets tend to yield consistent improvement in accuracy with a growing number of parameters, without any signs of performance degradation or overfitting. Under multiple settings, it achieved state-of-the-art results across several highly competitive datasets. Moreover, densenetsrequire substantially fewer parameters and less computation to achieve state-of-the-art performances.

[6] S.Maheshwari et.al (2017) This paper explains, the methods for glaucoma diagnosis. In, various frequency bands image breakdown is used for EWT. Then obtained correntropy features from the image. Feature ranking is done for the value of the t value feature selection algorithm. The vector machine classifier supported by least-squares classifies the image between glaucomatous or no glaucomatous images. This approach boosts 98.33% accuracy.

[7] Silvia Ovreiu et.al (2020) This paper explains, around the world, the main cause of glaucoma is permanent blindness. The early detection of glaucoma is possible only through a frequent eye examination and it has crucial importance in preventing blindness.So early detection is difficult. Convolutional neural networks play an important role in detecting glaucoma. In this paper, the early detection of glaucoma can be detected to propose a method called a densely connected neural network. We use a dense net with 121 layers and it can be pretrained on an image dataset. Then we obtain an accuracy of 95.6%. To avoid irreversible blindness produced by glaucoma, convolutional neural network algorithms have the power to become a cost-effective tool for screening the population.

[8]Bijnya Birajita Panda et.al (2021) Using artificial intelligence (AI) in ophthalmology is not very new and its use. Is expanding into numerous subspecialties of the eye like retina and glaucoma, thereby helping ophthalmologists to diagnose and treat sicknesses better thanearlier. Incorporating “deep studying” (a subfield of AI) into photograph-primarily based structuresalong with optical coherence tomography has dramatically advanced the machine'scapability to display screen and identify stages of diabetic retinopathy correctly. Similarpackages were tried within the area of retinopathy of prematurity and age-associated macular degeneration, a silent retinal condition that needs to be recognizedearly to prevent development. The arrival of AI into glaucoma diagnostics in analyzing visual fields and assessing sickness development also holds a promising function. However, there are a few great demanding situations inside the AI systems, including theincorporation of great photos, education units, and the black container catch 22 situations. Although; notwithstanding the present variations, there is continually a chance ofimproving the machines/software program to potentiate their efficiency and standards. Thisoverview article shall discuss the contemporary packages of AI in ophthalmology,large challenges, and the potentialities as to how both science and medicine canpaintings together.

SUMMARY FOR THE CLASSIFICATION OFGLAUCOMA DETECTION

AUTHORS	METHODS/FEATURE EXTRACTED/TECHNIQUE USED	ACCURACY
U. Raghavendra et al	non-parametric spatial envelope energy spectrum based method, Radon Transformation + Modified Census Transformation +	97%

	GIST descriptor + Locality Sensitive Discriminant Analysis LSDA	
S. Maheshwari et al	Empirical Wavelet Transformation, Correntropy based Feature extraction, Feature selection and ranking by t-value algorithm, Least Squares Support Vector Machine as a classifier	98.3%
Simon Thomas, S., et al	GLCM + 13 Haralick texture features and KNN as a classifier	98%
Annu, N., and Judith Justin et al	DWT based Textural Energy Features, Probabilistic Neural Network (PNN) Classifier	95%
Abhishek Pal et al	G-EYENET convolutional autoencoding classifier framework, and traditional CNN as a classifier, HRF, DRISHTI-GS,RIM ONE v3 dataset for training, DRIOND-DB for testing	92%
U Raghavendra, et al	18 layered CNN architecture, 1426 Fundus Images, 589 normal and 837 glaucomatous	98.13%
Xiangyu Chen et al	6 layered CNN, 2 convolution layers, 4 fully connected layers. Dataset: ORIGA and SCES	88%
Juan J. Gómez-Valverde et al	Transfer Learning. OD as ROI extraction, image scaling,VGG-19 used for transfer learning	94%
Alan Carlos de Moura Lima, et al	Features are extracted from CNN ResNet-50 with pre-trained weights from ImageNet challenge, Logistic Regression Classifier, RIM-ONE r2 as dataset	90%
Annan Li et al	Features extracted from AlexNet, VGG-16, VGG-19, GoogLeNet, ResNet-50, ResNet-152. Total number of features extracted: 19,456, SVM Classifier	83%
Yidong Chai et al	Multi-branch neural network (MBNN), use of Domain Knowledge: CDR,RNFLD,PPA, and Patient data	91.5%

METHODOLOGY

AI in ophthalmology started with gadget studying (ML).It approaches computerized behavior amendment after publicity to numerous inputs. Right here the inputs are the fundus images acquired with the aid of taking aerial photographs of the indoors of your eye through the student. Deep studying (DL) is a subset of machine studying (ML) that uses Convolutional Neural community (CNN). CNN is a type of synthetic neural network used in picture popularity. By way of gathering numerous fundus photographs of the attention, we make a dataset. Then the dataset may be analyzed completely by the usage of AI. In the deep learning future, extraction and classification are done in one stage. In the device getting to know destiny extraction and class are finished in stages. Right here theoutput obtained is referable and no referable. Here digital images providing millions of morphological datasets be analyzed in a comprehensive manner using artificial intelligence. Methods based on machine learning and particularly deep learning can identify, localize and quantify pathological features in every macular and retinal disease.

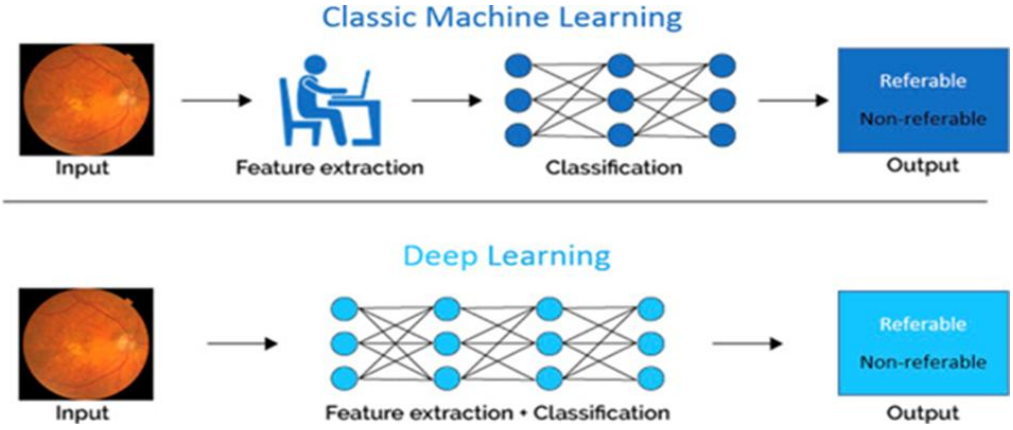

Fig 2 methodology

CONCLUSION

AI has a remarkable ability to carry out a whole lot higher than human beings in some duties. Mainly in image reputation subject. Automatic screening systems reduce the time required to decide prognosis and price for ophthalmologists and its effects in the well-timed remedy of patients. The automatic system plays a vital role in detecting diabetic retinopathy to an early degree. Convolutional neural networks have a massive capability of becoming a tool for automatic prognosis**.**

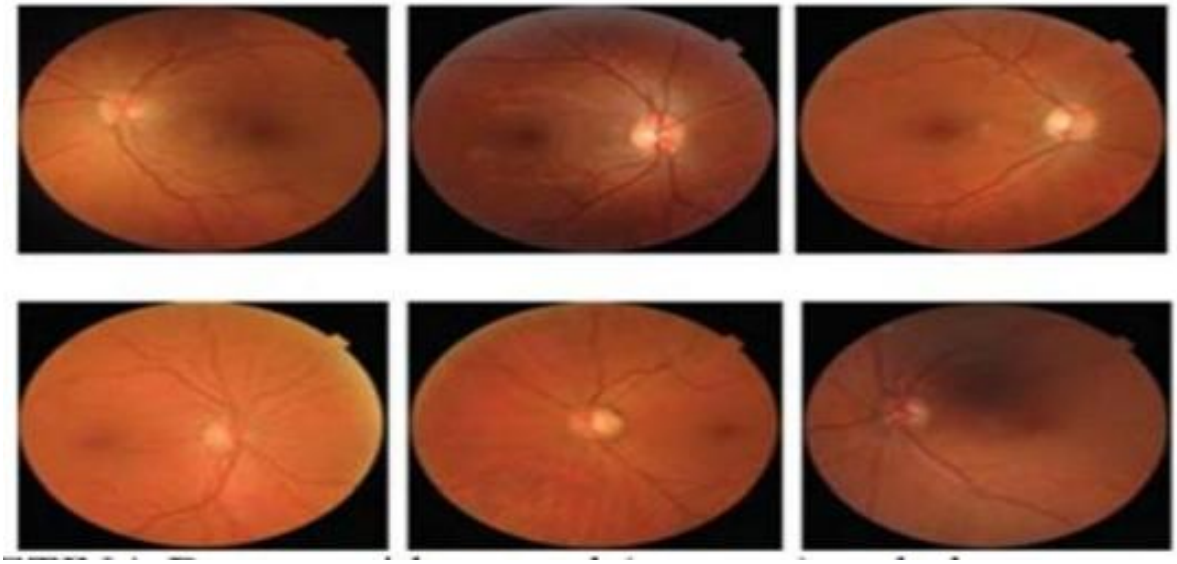

Fig 3Retina dataset with normal (top row) and glaucomatous images (bottom row)

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