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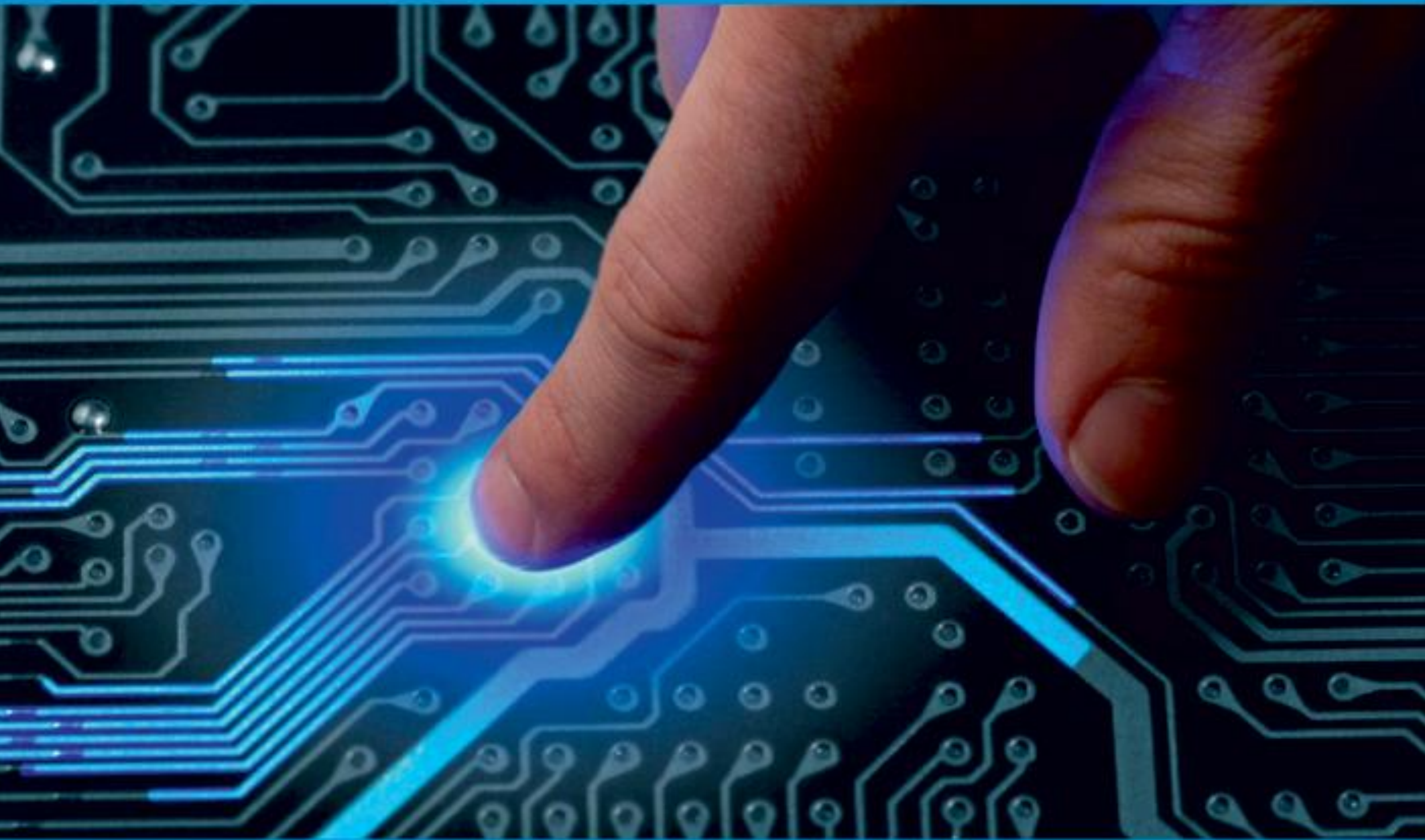

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Retinal Vessels Segmentation Based on Colon SeNet

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ABSTRACT: The morphology of blood vessels in retinal fundus images is an important indicator of diseases like glaucoma, hypertension and diabetic retinopathy. The accuracy of retinal blood vessels segmentation affects the quality of retinal image analysis which is used in diagnosis methods in modern ophthalmology. Existing diagnostic systems are not only prone to inaccurate judgments, but are also difficult and require a longer time from experts. Artificial intelligence (AI) based on deep learning (DL) has attracted global interest recently because of its effectiveness and accuracy in detecting eye disease. There are several challenges in diagnosing eye diseases based on retinal fundus imaging. Most of the previous models in the literature targeted these challenges and tried to improve the evaluation metrics, whereas very little attention has been given to reducing the computational complexity of the developed model. This project proposes a work in which any general lightweight DNN model could be used for vessel segmentation in retinal images as a proof of concept. Then applied a light weight DNN model for retinal vessel segmentation, based on the Colon SegNet model. Then retrained the Colon SegNet model using retinal vessel datasets. These results outperform several light weight and computationally heavy methods. The reduced number of parameters, computational complexity, and improved segmentation performance support its use in automated diagnostic systems for retinal vessel segmentation.

KEYWORDS: DNN model, Colon SegNet model, Artificial intelligence (AI), deep learning (DL).

I. INTRODUCTION

Due to the rapid progress in computing hardware, especially graphical processing units (GPUs), and their cheap availability in the last two decades, efficient deep learning (DL) frameworks have been explored for solving different problems in various fields of science. Artificial intelligence (AI), based on DL, has attracted global interest in recent years. Medicine and healthcare are not exceptions, where DL has been applied to medical imaging analysis, which has shown robust diagnostic ability in detecting different medical diseases. In ophthalmology, DL achieves robust classification performance in detecting and diagnosing various eye diseases, for instance, diabetic retinopathy (DR), age-related macular degeneration (AMD), and glaucoma. Retinal vessel segmentation is an essential pre-step for further geometrical and topological analysis on retinal vessel structures. An automatic and accurate vessel segmentation method can largely reduce the workload of manually labeling by experts and improve the efficiency of diagnosis in particular to large-scale screening programs.ML algorithms are categorized as supervised, un supervised and reinforcement learning. In supervised learning, the input and output data are labeled whereas in un supervised learning, the data are not labeled, and it is learned without supervision. Supervised methods are learned based on the features of the input images that are manually marked. In contrast, un supervised methods discover hidden features and do not require manually segmented images. In reinforcement learning, there is no input data, and it depends on the action soft the algorithm. Reinforcement learning seeks long- term cumulative rewards to achieve an optimal solution. On the other hand, supervised and unsupervised learning typically look for instant rewards.

II. REVIEW OF LITERATURE

R. Ju, Y. Chen, L. Zhang, (2019) proposed a Retinopathy of prematurity(ROP) is the leading cause of childhood blindness worldwide. Automated ROP detection system is urgent and it appears to be a safe, reliable, and cost-effective complement to human experts. An automated ROP detection system called Deep ROP was developed by using Deep Neural Networks (DNNs). ROP detection was divided into ROP identification and grading tasks. Two specific DNN models, i.e., Id-Net and Gr-Net, were designed for identification and grading tasks, respectively. To develop the DNNs,

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large-scale datasets of retinal fundus images were constructed by labeling the images of ROP screenings by clinical ophthalmologists.

Kumar VV, (2019) proposed as of past due, bunching manner has have become out to be notable for particular scientists due to particular software fields like correspondence, a ways flung systems control, and biomedical region, and plenty of others. on this way, a extensive kind of research has simply been made with the aid of the scientists to accumulate an progressed calculation for grouping. one of the first-rate technique among the experts is an improvement that has been efficaciously used for grouping. on this paper, Kinetic fuel Molecule Optimization (KGMO) in view of centroid instatement for picture department carried out for the fluffy c-implies bunching (FCM). The proposed framework is moreover named as KGMO-KFCM-BIM. For MRI cerebrum tissue branch, KFCM is maximum pleasant system in view of its precision. The extensive constraint of the standard KFCM is peculiar centroids instatement, because of the truth which devours the execution time to reach at the best arrangement. an awesome manner to quicken the division technique, KGMO is carried out to instate the centroids of required companies. The quantitative proportions of consequences have been checked out utilizing the measurements, as an example, cube coefficient, Jaccard co-proficient and precision. the quantity of emphasess and managing of KGMO-KFCM-BIM approach take least esteem at the same time as contrasted with not unusual KFCM. The KGMO-KFCM-BIM method is fantastically efficient and quicker than regular KFCM for mind tissue department.

Jebaseeli TJ, Durai CAD ,Peter JD, (2019) proposed a Diabetic Retinopathy (DR) occurs due to Type-II diabetes. It causes damages to the retinal blood vessels and reason for visual impairment. The predicted center is around the probability of variation in the estimation of retinal veins, and the crisp enrolls vessel development inside the retina. To witness the changes segmentation of retinal blood vessels has to be made. A framework to upgrade the quality of the segmentation results over morbid retinal images is proposed. This framework utilizes Contrast Limited Adaptive Histogram Equalization (CLAHE) for eliminating the background from the source image and enhances the foreground blood vessel pixels, Tandem Pulse Coupled Neural Network(TPCNN) model is endorsed for automatic feature vectors generation, and Deep Learning Based Support Vector Machine (DLBSVM) is proposed for classification and extraction of blood vessels. The DLBSVM parameters are fine-tuned via Firefly algorithm. The STARE, DRIVE, HRF, REVIEW, and DRIONS fundus image datasets are deliberated to assess the recommended techniques. The results render that the proposed technologies improve the segmentation with 80.61% Sensitivity, 99.54% Specificity, and 99.49% Accuracy.

Kaur S, Mann KS, (2019) proposed an algorithm that will segment the retinal blood vessels with an accuracy of 96.17%. This algorithm will extract the features from input images present in STARE and CHASE_DB1 databases. The extracted features will be large in number, but all the features are not useful. So, the feature optimization is done by Lion Optimization which has effectively chosen only the features which are useful in representing the extracted features as blood vessels or non-blood vessels. The algorithm was applied first on training images which have results of manually segmented images already. Then the algorithm was implemented on training images and evaluated on training images and it successfully detects the normal as well as abnormal images. The quantitative results were checked using parameters sensitivity, specificity, accuracy, positive predictive rate and false predictive rate and proved to give better results in comparison to existing techniques.

J. Benson, H. Carrillo, J. Wigdahl, S. Nemeth, (2018) proposed a Diabetic retinopathy (DR) is one of the dangerous complications of diabetes. Its grade level must be tracked to manage its progress and to start the appropriate decision for treatment in time. Effective automated methods for the detection of DR and the classification of its severity stage are necessary to reduce the burden on ophthalmologists and diagnostic contradictions among manual readers. In this research, convolutional neural network (CNN) was used based on colored retinal fundus images for the detection of DR and classification of its stages. CNN can recognize sophisticated features on the retina and provides an automatic diagnosis. The pre-trained VGG-16 CNN model was applied using a transfer learning (TL) approach to utilize the already learned parameters in the detection.

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III. PROPOSED SYSTEM

Retinal images are acquired using a high-resolution fundus camera, and this results in poor contrast between the background and retinal vascular structures. Thus, before accurate segmentation of the retinal vasculature, appropriate pre-processing techniques must be performed. This project have applied CLAHE to improve contrast based on the local context of the image. The fundus image is an RGB color image consisting of three channels (red, green, and blue).Extracting the blood vessels using a color fundus image can be accomplished by separating the retinal image into three channels and using only one of them. In this work, then used the blue channel image because it provides contrast between the background and blood vessels to identify the central reflex in the vessels.

This project aimed to develop a lightweight model for accurate retinal vessel segmentation, which can be used for the early diagnosis of eye diseases at the point of care in hospitals. Then applied a lightweight DNN model for retinal vessel segmentation, based on the Colon SegNet model. Then retrained the Colon SegNet model using retinal vessel datasets. Use Colon SegNet for retinal vessel segmentation and has achieved significantly improved evaluation metrics in addition to maintaining the reduced computational complexity of the model.Colon SegNet, which uses a residual block with a squeeze and excitation network. Finally the performance metrices are calculated. The calculated parameters are accuracy, sensitivity, specificity and Matthew's correlation coefficient (MCC).The focus of this work is to develop a lightweight model for accurate retinal vessel segmentation based on Colon SegNet. This project selected Colon SegNet because of its many advantages, including low computational complexity, and a low number of trainable parameters, which can be deployed on low-end devices. Hence, it can be used for the early diagnosis of eye diseases at the point of care in hospitals. Colon SegNet architecture has a lightweight network which leads to real-time performance because it is computationally efficient. It is an encoder-decoder architecture that produces segmentation of colonoscopic images in real-time.

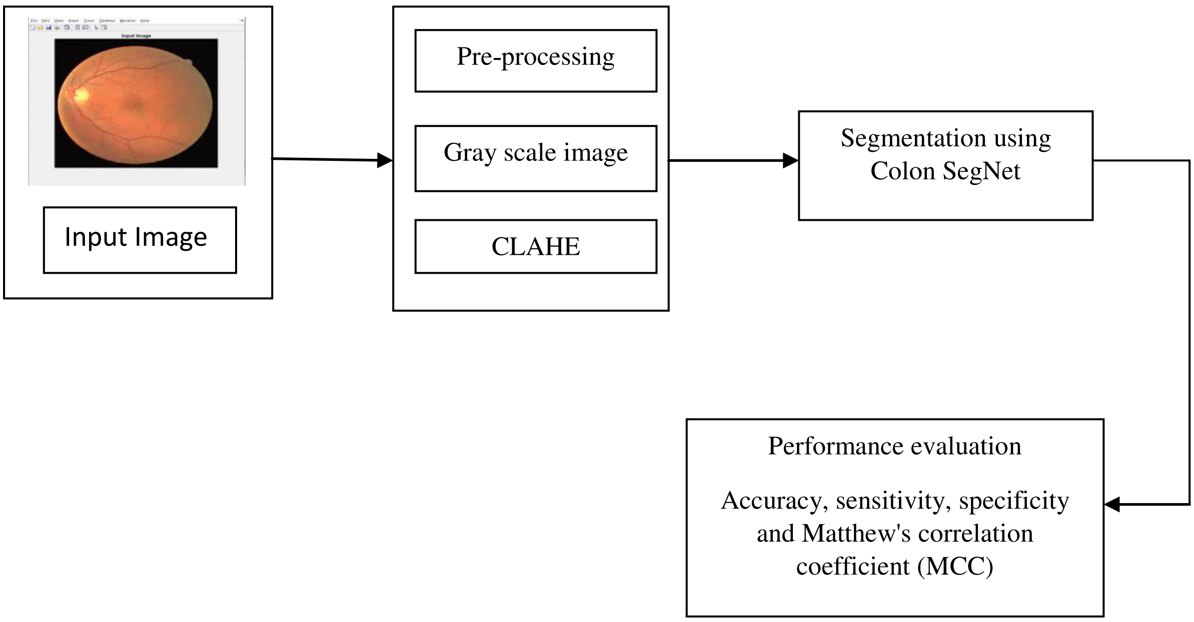

Fig 3.1 Block diagram

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IV. RESULT AND DISCUSSION

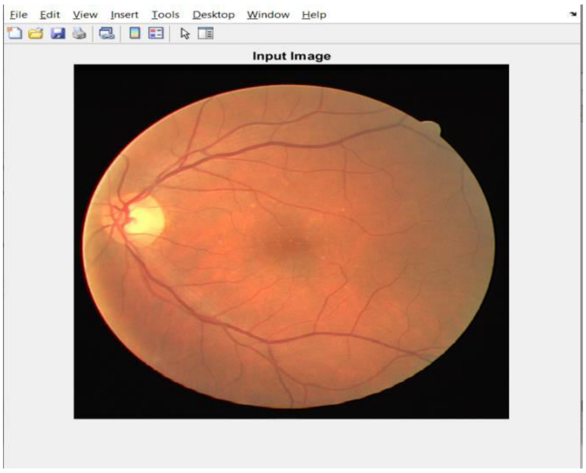

Fig 4.1 Input image

Fig 4.2 Gray image

Fig 4.3 CLAHE enhancement

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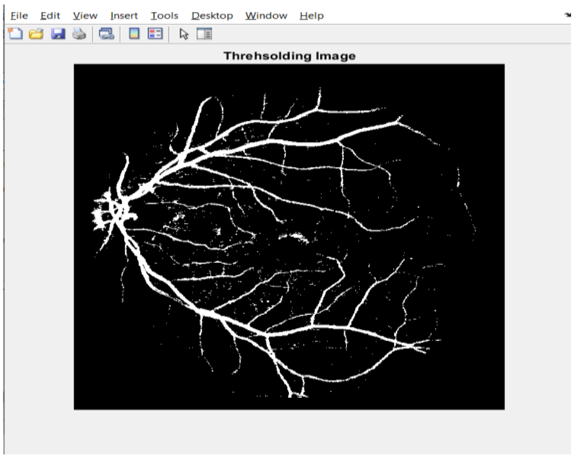

Fig 4.4 Thresholding image

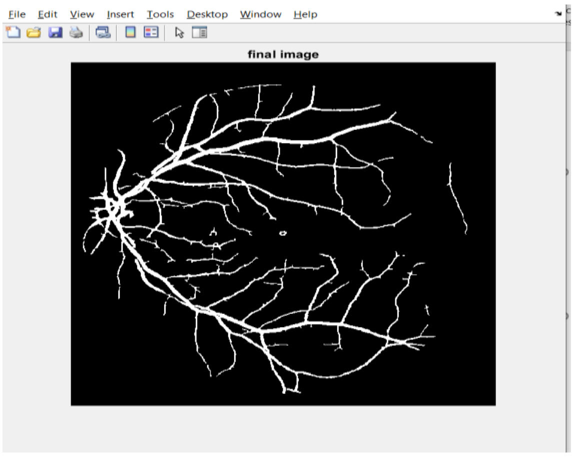

Fig 4.5 Segmented region

Evaluation Metrics:

Sensitivity: 0.88978

Specificity: 0.98713

Accuracy: 0.98104

Matthew's correlation coefficient (MCC): 0.84516

Fig 4.6 Performance metrices

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V. CONCLUSION AND FUTURE WORK

Retinal fundus images have been used for training and testing DNN models to develop automated diagnostic tools for eye disease diagnosis at an early stage. There are several challenges in diagnosing eye diseases based on retinal fundus imaging. Most of the previous state-of-the-art studies tried to develop DNN models to deal with some of the challenges. Most previous studies have focused on enhancing evaluation metrics. Computational complexity is an important factor, especially if a diagnostic tool is designed for large-scalescreening programs. In the literature, very little attentionhas been given to reducing the computational complexity of the developed model. Reduced computational complexity is highly desired, as the aim of developing an AI-enabled automated diagnostic system is to use for population scale(large-scale) screening programs, which will be possible if such tools are used at the front disks in a general hospital. This inspired us to propose a research work in which any general lightweight DNN model could be used for vessel segmentation in retinal images as a proof of concept. Then applied a lightweight DNN model for retinal vessel segmentation, based on the Colon SegNet model. Then retrained theColon SegNet model using retinal vessel datasets.

The proposed model is an appropriate choice for deployment in the computationally constrained computing facility at the point of care due to the advantages of being highly robust, reliable, and efficient in terms of segmentation accuracy in addition to being light weight. Future work will be focused on evolving extra actual segmentation systems using soft computing procedures named as Grey Wolf and Moth Blaze Optimization procedures.

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