ADA_ViT: Adaptive Drawer Algorithm for Vision Transformers to Detect the Severity of Diabetic Retinopathy

M. Prameela[1] and M. Kamala Kumari[2]

Department of Computer Science and Engineering, University College of Engineering,
Adikavi Nannaya University, Rajahmundry.

[1] prameela.mtech@gmail.com

[2] kamalamarepalli.aknu@gmail.com

ABSTRACT

Diabetic retinopathy (DR) is also referred as diabetic eye disease that causes retinal damage due and leads to blindness when it attains an extreme phase. The clinical examination accumulated longer progression, more time and it is expensive to examine for proliferative stage of DR (PDR). To conquer this bridge, a novel approach for severity detection of DR using fundus images named as ADA_ViT is developed. Firstly, input fundus image is preprocessed employing Non-Local Means Denoising (NLMD) to neglect the noise in an image. After that, lesion segmentation is performed by M-segNet to segment a particular region of an image. Then, feature extraction is carried out to extract the features. Finally, severity of DR classification is carried out by Vision Transformer (ViT), which is trained by Adaptive Drawer Algorithm (ADA). The ADA will be obtained by the combination of adaptive concept as well as the Drawer Algorithm (DA). Here, DR will be classified based on the severity into apparent DR, mild DR, moderate DR, Proliferative DR, and severe DR. The analytic metrics evaluated for ADA_ViT namely, accuracy, sensitivity and specificity acquired maximal values of 0.875, 0.946 and 0.916.

Keywords: Diabetic retinopathy (DR), Fundus image, Vision transformers, Microaneurysms, Drawer Algorithm (DA).

INTRODUCTION

Diabetes Mellitus is also named as diabetes that referred as a disorder wherein the patient faces more blood sugar levels for a long period of time [11]. Diabetes creates more obstacles that involve vision mutilation because of DR, heart attacks, kidney failure, and stroke [4]. Microvascular complication of diabetes is DR [11]. Due to diabetic retinopathy, people amid the age of 20 to 74 might have blindness [1]. DR is majorly categorized into two namely, Non-Proliferative Diabetic Retinopathy (NPDR) and Proliferative Diabetic Retinopathy (PDR) [12]. NPDR is the prime stage of diabetic eye disease where fluid reveals damaged blood vessels and creates small lesions like red-colored microaneurysms (MA), dark red patch-like Hemorrhages and bright yellow exudates on retina surface. Early DR detection may play a vital role in vision loss prevention. The analysis of retinal fundus image is a useful medical progressing operation [4]. Along with suitable information these images accumulates the retina and its essence [13]. Ophthalmologists may utilize the blood vessel segmentation of retina to aid them treat various

and 0.916. The future work will be implemented in DR using fundus image will develop automated systems that may predict and examine based on DL features.

References

[1] Bilal, A., Zhu, L., Deng, A., Lu, H. and Wu, N., "AI-based automatic detection and classification of diabetic retinopathy using U-Net and deep learning', Symmetry, vol.14, no.7, pp.1427, 2022.

[2] Dayana, A.M. and Emmanuel, W.S., "An enhanced swarm optimization-based deep neural network for diabetic retinopathy classification in fundus images", Multimedia Tools and Applications, vol.81, no.15, pp.20611-20642, 2022.

[3] Asia, A.O., Zhu, C.Z., Althubiti, S.A., Al-Alimi, D., Xiao, Y.L., Ouyang, P.B. and Al-Qaness, M.A., "Detection of diabetic retinopathy in retinal fundus images using CNN classification models", Electronics, vol.11, no.17, pp.2740, 2022.

[4] Nneji, G.U., Cai, J., Deng, J., Monday, H.N., Hossin, M.A. and Nahar, S., "Identification of diabetic retinopathy using weighted fusion deep learning based on dual-channel fundus scans", Diagnostics, vol.12, no.2, pp.540, 2022.

[5] The IDRID dataset will be taken from "https://ieee-dataport.org/open-access/indian-diabetic-retinopathy-image-dataset-idrid", accessed on September 2023.

[6] Wan, S., Liang, Y. and Zhang, Y., "Deep convolutional neural networks for diabetic retinopathy detection by image classification', Computers & Electrical Engineering, vol.72, pp.274-282, 2018.

[7] Yamanakkanavar, N. and Lee, B., "A novel M-SegNet with global attention CNN architecture for automatic segmentation of brain MRI", Computers in Biology and Medicine, vol.136, pp.104761, 2021.

[8] Xie, S., Shan, S., Chen, X. and Chen, J., "Fusing local patterns of gabor magnitude and phase for face recognition", IEEE transactions on image processing, vol. 19, no. 5, pp.1349-1361, 2010.

[9] Dosovitskiy, A., Beyer, L., Kolesnikov, A., Weissenborn, D., Zhai, X., Unterthiner, T., Dehghani, M., Minderer, M., Heigold, G., Gelly, S. and Uszkoreit, J., "An image is worth 16x16 words: Transformers for image recognition at scale", arXiv preprint arXiv:2010.11929, 2020.

[10] Trojovska, E., Dehghani, M. and Leiva, V., "Drawer Algorithm: A New Metaheuristic Approach for Solving Optimization Problems in Engineering", Biomimetics, vol.8, no.2, pp.239, 2023.

[11] Adak, C., Karkera, T., Chattopadhyay, S. and Saqib, M., "Detecting Severity of Diabetic Retinopathy from Fundus Images using Ensembled Transformers", arXiv preprint arXiv: 2301.00973, 2023.

[12] Saranya, P., Prabakaran, S., Kumar, R. and Das, E., "Blood vessel segmentation in retinal fundus images for proliferative diabetic retinopathy screening using deep learning", The visual computer, pp.1-16, 2022.

[13] Sikder, N., Masud, M., Bairagi, A.K., Arif, A.S.M., Nahid, A.A. and Alhumyani, H.A., "Severity classification of diabetic retinopathy using an ensemble learning algorithm through analyzing retinal images', Symmetry, vol.13, no.4, pp.670, 2021.

[14] Hemanth, D.J., Deperlioglu, O. and Kose, U., "An enhanced diabetic retinopathy detection and classification approach using deep convolutional neural network", Neural Computing and Applications, vol.32, pp.707-721, 2020.

[15] Jabbar, M.K., Yan, J., Xu, H., Ur Rehman, Z. and Jabbar, A., "Transfer learning-based model for diabetic retinopathy diagnosis using retinal images", Brain Sciences, vol.12, no.5, pp.535, 2022.