diagnostics

MDPI

Article

HDR-EfficientNet: A Classification of Hypertensive and Diabetic Retinopathy Using Optimize EfficientNet Architecture

Qaisar Abbas [1,*], Yassine Daadaa [1], Umer Rashid [2], Muhammad Zaheer Sajid [3] and Mostafa E. A. Ibrahim [1,4]

[1] College of Computer and Information Sciences, Imam Mohammad Ibn Saud Islamic University (IMSIU), Riyadh 11432, Saudi Arabia; ymdaadaa@imamu.edu.sa (Y.D.)
[2] Department of Computer Science, Quaid-i-Azam University, Islamabad 44000, Pakistan; umerrashid@qau.edu.pk
[3] Department of Computer Software Engineering, MCS, National University of Science and Technology, Islamabad 44000, Pakistan
[4] Department of Electrical Engineering, Benha Faculty of Engineering, Benha University, Benha 13518, Qalubia, Egypt
* Correspondence: qaabbas@imamu.edu.sa; Tel.: +966-537014011

Abstract: Hypertensive retinopathy (HR) and diabetic retinopathy (DR) are retinal diseases closely associated with high blood pressure. The severity and duration of hypertension directly impact the prevalence of HR. The early identification and assessment of HR are crucial to preventing blindness. Currently, limited computer-aided methods are available for detecting HR and DR. These existing systems rely on traditional machine learning approaches, which require complex image processing techniques and are often limited in their application. To address this challenge, this work introduces a deep learning (DL) method called HDR-EfficientNet, which aims to provide an efficient and accurate approach to identifying various eye-related disorders, including diabetes and hypertensive retinopathy. The proposed method utilizes an EfficientNet-V2 network for end-to-end training focused on disease classification. Additionally, a spatial-channel attention method is incorporated into the approach to enhance its ability to identify specific areas of damage and differentiate between different illnesses. The HDR-EfficientNet model is developed using transfer learning, which helps overcome the challenge of imbalanced sample classes and improves the network's generalization. Dense layers are added to the model structure to enhance the feature selection capacity. The performance of the implemented system is evaluated using a large dataset of over 36,000 augmented retinal fundus images. The results demonstrate promising accuracy, with an average area under the curve (AUC) of 0.98, a specificity (SP) of 96%, an accuracy (ACC) of 98%, and a sensitivity (SE) of 95%. These findings indicate the effectiveness of the suggested HDR-EfficientNet classifier in diagnosing HR and DR. In summary, the HDR-EfficientNet method presents a DL-based approach that offers improved accuracy and efficiency for the detection and classification of HR and DR, providing valuable support in diagnosing and managing these eye-related conditions.

Keywords: diabetic retinopathy; hypertensive retinopathy; deep learning; transfer learning; convolutional neural network; inception model

Citation: Abbas, Q.; Daadaa, Y.; Rashid, U.; Sajid, M.Z.; Ibrahim, M.E.A. HDR-EfficientNet: A Classification of Hypertensive and Diabetic Retinopathy Using Optimize EfficientNet Architecture. *Diagnostics* **2023**, *13*, 3236. https://doi.org/10.3390/diagnostics13203236

Academic Editor: Jae-Ho Han

Received: 22 August 2023
Revised: 3 October 2023
Accepted: 16 October 2023
Published: 17 October 2023

1. Introduction

In the United States, hypertension affects approximately 9.5 million individuals [1], which is anticipated to grow. It is a common, universal ailment. The retina and the retinal arteries undergo many alterations due to the rise in blood pressure, or HR. Early HR identification is crucial as it can increase cardiovascular risk and retinal microcirculation. These two HR-related diseases have been identified in a large population of hypertensive people. As HR symptoms [2] appear, many people experience visual loss. Recent research has shown that retinal microvascular changes may be seen using a fundus digital camera.