NEW TRANSFER LEARNING-BASED HYBRID DEEP MODEL FOR MULTICLASS EYE DISEASE CLASSIFICATION WITH INCEPTION V3 AND TAILORED CNN BLOCKS

Subhadip Das[1], Tanmay Kumar Behera[2], Deblina Roy[1], Shruti Pandey[1], Sanchari Mohanty1, Atasi Dutta[1] , and Kousik Roy[1*]

[1]Department of Computer Science and Engineering, Bengal College of Engineering and Technology, Durgapur, West Bengal

[2]Department of Computer Science and Engineering, NIT Mizoram, India

*Corresponding Author Email ID: kousikroy002@gmail.com

ABSTRACT

Glaucoma, diabetic retinopathy, and cataract-each of these eye ailments are threatening to the complete loss of vision if not detected early. To aid this, a hybrid deep learning model was built by an amalgamation of InceptionV3 along with the additional custom convolution layers and dense layers for enhanced classification of retinal fundus images. The model was trained on a well-balanced dataset of 4,200 images after resizing to 224 × 224 × 3 for efficiency, with 80% of the data going to training, 10% to validation, and 10% to testing sets. Preprocessing implemented noise addition, contrast enhancement, and normalization. Training was performed for 50 epochs with adaptive learning rate scheduling, achieving accuracies of 99.49% on training data, 95.84% on validation data, and 96.32% on testing data. The good results emphasize the applicability of this model in clinical practice.

Keywords: *Eye Disease Classification, Deep Learning, CNN, InceptionV3, Diabetic Retinopathy, Medical Imaging*

1. INTRODUCTION

Imagine how close to two billion people in the whole world population suffering from less-than-normal distant vision or blindness. Such an affliction poses great public health challenges in both developed and developing regions [1]. Diabetic retinopathy (DR), age-related macular degeneration (AMD), glaucoma, and cataract rank high as causes, with the top four coming to account for over 75 percent of global blindness cases [2]. According to the World Health Organization (WHO), about 1.5 billion people are today affected by distance vision impairment, and this number is expected to rise to 2.4 billion by 2050 due to worldwide aging, urbanization, and lifestyle changes [3][4]. Early diagnosis can curb the permanent loss of vision but catching it in time within many regions is a huge challenge. This is particularly so in low- and middle-income countries (LMICs) where specialists are scarce, diagnostic tools expensive, and assessment mostly left to subjective judgment [5]. Over the past few years, deep learning (DL) has received attention in medical imaging due to its speed and accuracy over traditional methods [6]. CNNs and transfer learning have proven exceptional in training systems for eye disease classification. Kashyap et al. [7] provided U-Net enhanced with DenseNet-201 for glaucoma, while Hussain et al. [8] fed OCT and visual field data through a CNN-LSTM. Mariottoni et al. [9] and Mandal et al. [10] upgraded the classification with deep hybrid and GAN approaches. This study presents a hybrid model integrating InceptionV3 with tailoring CNN layers trained with 4,200 retinal images to detect DR cataract and glaucoma. Being a hybrid model, it provides a truly scalable and effective automated-based solution for the diagnosis of retinal diseases.

2. PROPOSED METHODOLOGY

This research provides an outline of a deep learning framework to detect and classify common ocular diseases based on retinal fundus images. To provide good generalization and to reduce overfitting, different image augmentations were applied: rotation, flipping, cropping, and scaling. The dataset was fairly split into three subsets for training, validation and testing. Preprocessing techniques