Bangabandhu Sheikh Mujibur Rahman Science and Technology University
Department of Computer Science and Engineering

Research Project Proposal

Research Title: Comparison of smartphone-based retinal imaging systems for diabetic retinopathy detection using deep learning.

Type: Quantitative Research

Student Information:

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Session	2018-19

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Abstract/Summary: Diabetic retinopathy (DR), the most common cause of vision loss, is caused by damage to the small blood vessels in the retina. If untreated, it may result in varying degrees of vision loss and even blindness. DR is a silent disease that may cause no symptoms or only mild vision problems. Fundus cameras are used to capture retinal image to detect DR. Since smartphone-based retinal imaging systems have much more compact designs than a traditional fundus camera, captured images are likely to be the low quality with a smaller field of view. Our motivation in this paper is to develop an automatic DR detection model for smartphone-based retinal images using the deep learning approach with the CNN. So, we investigate the smartphone-based portable retinal imaging systems and compare their image quality and the automatic DR detection accuracy using a deep learning framework. Smartphone-based retina imaging systems plays an important role in determining the automatic DR detection accuracy.

Introduction: A diabetic person is at high risk of eye disease including diabetic retinopathy, diabetic macular edema, cataract, and glaucoma. The most common cause of vision loss is the diabetic retinopathy (DR) that is caused by bleeding of the small blood vessels in the retina. If these bloody retina veins are untreated, it may cause to varying degrees of vision loss and even blindness. Early detection could improve the chances of effective treatment to prevent blindness, doctors suggest the regular annual eye exams for diabetic patients. In the retina examination, doctors use special optical devices such as an ophthalmoscope, 20D lens, and fundus camera. Smartphone-based systems are very popular in several applications ranging from health care to entertainment since they make existing systems small and portable. Because of fundus cameras are large-size, heavy-weight, and high-price devices, we investigate the smartphone-based portable retinal imaging systems available on the market and compare their image quality and the automatic DR detection accuracy using a deep learning framework.

Related Literature Review: This literature review explores the intersection of deep learning models and smartphone technology for the detection of diabetic retinopathy (DR). Recognizing DR as a leading cause of blindness, the review highlights the potential of smartphones as accessible tools for widespread and early diagnostics. Key themes include the adaptation of deep learning models, such as convolutional and recurrent neural networks, for real-time analysis on smartphones. Advances in smartphone imaging technology and the curation of diverse datasets contribute to the reliability of these models. The review emphasizes user-friendly interfaces, accessibility, and the role of smartphones in telemedicine.

In this paper overall classification accuracy of smartphone-based systems are sorted as 61%, 62%, 69%, and 75% for iExaminer, D-Eye, Peek Retina, and iNview images, respectively[1]. We observed that the network DR detection performance decreases as the field of view of the smartphone-based retinal systems get smaller where iNview is the largest and iExaminer is the smallest. So we try to improve the accuracy rate of the smartphone-based system.

Research Methodology:

The research Methodology for "Comparison of smartphone-based retinal imaging systems for diabetic retinopathy detection using deep learning." is mainly incorporating Dataset collecting & Building, Dataset Pre-processing, Training and class predict as DR or NO_DR. The subsequent phase involves to pre-processing comprehensive dataset. Grayscaling, thresholding, masking are used to crop the retinal images from eye images for building dataset. In training phase DenseNet169, MobileNet, ResNet152V2, VGG16, VGG19, Xception model is implemented to extract hierarchical features from images, including subtle patterns and textures indicative of diabetic retinopathy. ResNet152V2.h5 model is saved and used to calculate the test accuracy and predict the class as DR or NO_DR.

Result Analysis: To compare the smartphone-based retinal imaging systems, we set up two sets of experiments using retina images and real fundus images. We first collected retina images from kaggle. To make the fair comparison between different retinal imaging systems, we captured retinal images with iPhone 6, iPhone 15, one plus, vivo, realme using their compatible adapters and bumpers. We create an app to capture images to capture the retina images without color artifacts, blurring and contrast problems. In order to capture an image of the dark retina, we first needed to use a light source for illumination and 20D lens. For this purpose, we reflected the smartphone flashlight to the. The smart phone's camera was used to capture retina images and images were saved to the smartphone's memory.

Expected Results: First the results of our networks for the original fundus camera images to investigate their strengths and weaknesses by comparing. Second, we investigated the effect of using retina images from the datasets in training and validation. Third, these results were also compared with the smartphone based retina images and must try to improve the accuracy rate of the previous result.

Significance and Implications of the Study: Since smartphone-based retinal imaging systems have much more compact designs than a traditional fundus camera, captured images are likely to be the low quality with a smaller field of view. Our motivation in this paper is to develop an automatic DR detection model for smartphone-based retinal images using the deep learning.

Reference:

[1] Karakaya, M., & Hacisoftaoglu, R. E. (2020). Comparison of smartphone-based retinal imaging systems for diabetic retinopathy detection using deep learning. *BMC bioinformatics*, *21*(4), 1-18.

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Supervisor Signature and Seal

Signature of the Board Members: (Use for presentation's Board)

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Comment: i) Accept ii) Conditional Accept iii) Not Accept

Recommend for Project Exhibition: Yes / No