DIABETIC RETINOPATHY DETECTION USING DEEP LEARNING

[1]M.BUVANESWARI, [2]R.SOWNDARYA LAKSHMI, [3]A.SUJITHA

[1]Assistant Professor, [2]Student, [3]Student
[1]Computer Science and Engineering,
[1]Paavai Engineering College, Nammakkal, India

***Abstract*: Diabetic retinopathy is when damage occurs to theretina due to diabetes, which affects up to 80percent of all patients who have had diabetes for10 years or more. The expertise and equipmentrequired are often lacking in areas where diabeticretinopathy detection is most needed. Most of thework in the field of diabetic retinopathy has beenbased on disease detection or manual extraction offeatures, but this paper aims at automaticdiagnosis of the disease into its different stagesusing deep learning. This paper presents thedesign and implementation of GPU acceleratedeep convolutional neural networks toautomatically diagnose and thereby classify high-resolution retinal images into 5 stages of thedisease based on severity. The single modelaccuracy of the convolutional neural networkspresented in this paper is 0.386 on a quadraticweighted kappa metric and ensembling of threesuch similar models resulted in a score of 0.3996.**

INTRODUCTION

Diabetic Retinopathy is a diabetes complication that damages the light-sensitive retina tissues and blood vessels due to high blood sugar rates, macular changes such as yellowish spots, aneurysms (an increase of the microvascular thickness or "ballooning" in the retina), and hemorrhage (blood escaping from blood vessels) are considered the most common implications of DR. Macular irregularities in diabetic patients were first detected in 1856 by Eduard Jaeger. However, those were not confirmed to be related to diabetes until 1872, when Jaeger first provideda histopathologic proof of "cystoid degeneration of the macula" in diabetic patients. Several studieswere carried in the following years leading to the discovery of Proliferative Diabetic Retinopathy by Wilhelm Manz in 1876. As stated by Mayo Clinic,common symptoms of DR include spots in vision, blurred or fluctuated sight, color impairment, and in some severe cases, a complete vision loss in one or both eyes. In the long term, high blood sugar rates cause blockage in the microvessels of the retina, which are very important for nourishingthe retina tissues, therefore, the eye attempts to grow new vessels to supply the retina with the needed nutrients and oxygen, however, these generated vessels are weak and likely to suffer blood leakage forming a hemorrhage in the retina. According to the severity of the detected symptoms, DR is graded into one of 3 stages; Mild, Moderate, and Proliferative DR (PDR).
Diabetic retinopathy (DR), also known as diabetic eye disease, is when damage occurs to the retina due to diabetes. It can eventually lead to blindness. It is an ocular manifestation of diabetes. Despite these intimidating statistics, research indicates that at least 90% of these new cases could be reduced ifthere were proper and vigilant treatment and monitoring of the eyes. The longer a person has diabetes, the higher his or her chances of developing diabetic retinopathy. Diabetic retinopathy can be diagnosed into 5 stages: mild, moderate, severe, proliferative or no disease. The various signs and markers of diabetic retinopathy include microaneurysms, leaking blood vessels, retinal swellings, growth of abnormal new blood vessels and damaged nerve tissues. DR detection is challenging because by the time human readerssubmit their reviews, often a day or two later, the delayed results lead to lost follow up, miscommunication, and delayed treatment.


A Convolutional Neural Network (CNN) is comprised of one or more convolutional layers(often with subsampling step) and then followed by one or more fully connected layers as in astandard multilayer neural network. Thearchitecture of a CNN is designed to take advantage of the 2D hierarchical structure of an input image (or other 2D input such as a speech signal). This is achieved with local connections and tied weights followed by some form of pooling which results in translation invariant features. Another benefit of CNNs is that they are easier to train and have many fewer parameters than fully connected networks with the same number of hidden units. CNNs also consider the hierarchical representation of images whiletraining by stacking multiple trainable stages on each other.
These AR modelling based methods deal only stationary signal i.e. the assumption was made by these methods that frequency (spectral) contentsof the signal do not vary over the time. Since the spectral information of the EEG signal is seen to differ at

different time, demonstrating that the EEG signal is non-stationary in nature. As an outcome, such a feature extraction strategy ought to be picked which can display the non-stationary impact of the signal for better representation

THE DATA SET

The data set consists of 35,126 labeled high- resolution colour fundus retinal images belonging to five classes corresponding to the five stages of the disease as portrayed in he images have been open-sourced by EyePACs, a free platform for retinopathy screening. A trained clinician has ratedthe presence of diabetic retinopathy in each image on a scale of 0 to 4. The images in the data set come from different models and types of cameras, which can affect the visual appearance of left and right retinas. Some images are shown as one wouldsee the retina anatomically (mascula on the left, optic nerve on the right for the right eye). There is also noise in both the images and labels. Images may contain artifacts, be out of focus, underexposed, or overexposed and are of different resolutions.

DATA PRE-PROCESSING

Due to non-standard image resolutions, the trainingimages could not be utilized directly for training. The images were scaled down to a fixed resolution size of 512x512 pixels to form a standardized data set. Training images of resolution 512x512 pixels on all three colour channels demanded highmemory requirements. Due to this limitation, the images were converted to a single channel. After several experiments, it was found that green channel images retained information better than theother channel images. In order to enhance the contrast of the image evenly across pixels, histogram equalization technique was applied on the images. In order to prevent the convolutional neural network from learning the inherentbackground noise in the image, each image was normalized using Min-Max normalization.

Original Image Green Channel Image

CLINICAL FEATURES &CLASSIFICATION

Retinopathy of prematurity is generally classified according to the International Classification of ROP (ICROP) . This classification system uses retinal landmarks to minimize inter-examinervariability. ROP is classified based on the zone, extent of disease, stage, and followed by documentation of the status of the vessels in the posterior pole (plus disease).

Staging:

It indicates the degree of abnormal vascular changes at the junction of the vascular and avascular retina. The vascularized retina of premature infants without ROP blends almost imperceptibly into the anterior, non-vascularized retina. These are called immature retinal vessels. Some also call it as stage 0 ROP. With the onsetof clinically apparent ROP, the junction between the vascularized and avascular retina becomes more pronounced. There are 5 stages to describe the abnormal vascular response at the junction of vascularised and avascular retina.

(a) Stage 1- Demarcation line: The demarcation line is seen as a distinct white and flat line but stilllies within the plane of the retina, which separates the avascular retina anteriorly from vascular retinaposteriorly

(b) Stage 2- Ridge of elevated tissue: In thisstage the demarcation line will have height and width. This ridge may be white or pink and rarely,vessels may leave the surface of the retina to enterit.

(c) Stage 3- Ridge with extraretinal fibrovascular proliferation: This stage is characterised by extraretinal, fibrovascular tissue proliferating from the ridge into the vitreous. The proliferating tissue is localised continuous withthe posterior and interior aspect of the ridge, causing a ragged appearance of the ridge

(d) Stage 4- Subtotal retinal detachment: Thisis characterised by partial detachment of the retinawhich may be due to exudative effusion of fluid, traction or both. This stage is sub divided into stage 4A, which is extrafoveal retinal detachment. It is a convex tractional detachment which occurs in the periphery without macular involvement . Stage 4B consists of partial retinal detachmentinvolving the fovea .

(e) Stage 5- Total Retinal Detachment: This is the end stage where there is total detachment . Thedetachment is mostly funnel shaped, and the funnel is usually divided into anterior and posterior part.

SYSTEM ANALYSIS

EXISTING SYSTEM

Retinopathy of Prematurity (ROP) is a disease which requires immediate precautionary measures to prevent blindness in the infants, and this condition is prevalent in premature babies in all theunderdeveloped, developing, and in the developed countries as well.

DRAWBACKS OF EXISTING SYSTEM This has become increasingly prevalent. It may be less affected with no effects to the visual, or very prevalent with neovascularization which is new vessel formation and can move on to become retinal detachment or blindness.

PROPOSED SYSTEM

ROP plus disease likely exists as a continuous spectrum of retinal vascular abnormality. Thus, theperformance of the convolution neural network algorithm in detecting intermediate and less severe pre-plus disease was evaluated. The statistical performance of the classifier was evaluated in an expanded external test set of fungal images, which comprised of the initial external test set of normal retina image and disease images, with an additional preplus disease fungal images. Statistical performance was measured by calculating sensitivity, specificity, accuracy, positive predictive value, and negative predictive value measured.

ADVANTAGES OF PROPOSED SYSTEM

Our tool is based on image processing which is easy and simple for processing the image using Matlab. We have used Matlab 2015a in which the image processing tool provides us a reference for algorithms which is a standard set, functions whichcan be used, and a good platform for image processing, image analysis, visualization of image, and algorithm calculation.

FEASIBILITY STUDY

The feasibility Analysis is an analytical program through project manager determines the project success ratio and through feasibility study project manager able to see either project.

- Economic Feasibility
- Technical Feasibility
- Operational Feasibility
- Environmental Feasibility

Economical feasibility

Hence this project is economically feasible thereis no need to involve any cost for this project.

Technical feasibility

Software Technologies used are PHP and MySql. In the educational institutions, it is possible toupdate the system in future. No special hardwareis required for the purpose of using this system. Hence it is declared that this project is technically feasible.

Operational feasibility

As the admin work mainly to maintain the Patient and Doctor .Doctor will predict patient cancer or retinal disease. Hence it is easy to operate with training. Therefore it is operationally feasible for implementation.

Environmental feasibility

This project environment is correct as a admin hasdeveloped this system and no expenditure is involved under any head and this process is part ofadmin document management, this project environment is accessible.

TESTING AND DESIGNTESTING

Implementation is the stage of the project when the theoretical design is turned into a workingsystem. This is the final and important phase inthe system life cycle It is actually the process of converting the new system into a operational one.It involves Unit Testing and Black Box testing.

UNIT TESTING

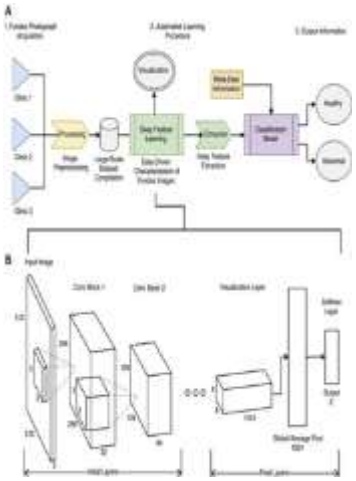
Unit testing comprises the set of tests performed by an individual programmer prior to integration of the unit into a larger system. The module interface is tested to ensure that information properly flows into and out of the program unit. The local data structure is examined to ensure thatdata stored temporarily maintains its integrity during all steps in an algorithm's execution. Boundary conditions are tested to ensure that the module operates properly at boundaries established to limit or restrict processing. All independent paths through the control structureare tested. All error-handling paths are tested.

BLACK BOX TESTING

Black-box testing is a method of software testing that examines the functionality of an application without peering into its internal structures or workings. This method of test can be applied virtually to every level of software testing: unit, integration, system and acceptance. It is sometimesreferred to as specification-based testing.

SYSTEM DESIGN

Implementation is the stage of the project when thetheoretical design is turned into a working system. This is the final and important phase in the system life cycle It is actually the process of convertingthe new system into a operational one.



CONCLUSION

This paper presents the design, architecture and implementation of deep convolutional neural networks for automatic detection and classification of diabetic retinopathy from color fundus retinal images. It also discusses the qudratic kappa metric used to evaluate the prediction results. This research involves three major CNN models, designing their architectures and finding the corresponding quadratic kappa scores. The best score of 0.3996 is obtained by theensemble of these three models.

REFERENCES

1. Alex Krizhevsky, Ilya Sutskever, Geoffrey E.Hinton. Image Net Classification with Deep Convolutional Neural Network. Advances in Neural Information Processing System 25, 2012
2. Y. LeCun, K. Kavukcuoglu, and C. Farabet. Convolutional networks and applications in vision. In Circuits and Systems (ISCAS), Proceedings of 2010 IEEE International Symposium on, pages 253256. IEEE, 2010.
3. Karen Simonyan, Andrew Zisserman. Very Deep Convolutional Networks for Large- Scale Image Recognition. ICLR 2015.
4. Ian J. Goodfellow, David Warde-Farley, Mehdi Mirza, Aaron Courville, Yoshua Bengio. Maxout Networks 20 Sep 2013
5. Nitish Srivastava, Geoffrey Hinton, Alex Krizhevsky, Ilya Sutskever, Ruslan Salakhutdinov. Dropout: A Simple Way to Prevent Neural Networks from Overfitting. Journal of Machine Learning Research 15 (2014).