Research Journal of Computer Systems and Engineering
ISSN: 2230-8571, 2230-8563
Volume 01 Issue 02 - 2020 (July to December)
Page 20:25

Cataract Eye Detection Using Deep Learning Based Feature Extraction with Classification

Waleed F. Faris
Professor,
International Islamic University Malaysia,
Kuala Lumpur- 53100, Malaysia
https://orcid.org/0000-0002-1219-8793

Article History	***Abstract***
Received: 15 July 2020 Revised: 20 September 2020 Accepted: 22 November 2020	More over 50% of blindness in the industrialised world is caused by cataracts, making them one of the most common causes of blindness. This research aims to design earlier cataract detection using machine learning technique. Here the dataset has been collected through the IOT module from the public health dataset. This data has been pre-processed, and then the data has been pre-trained for better data classification using K- NEURAL NETWORKS (K-NeuNet). By this pre-trained data the detection has been carried out, when the image detected with symptoms of cataract eye, the data has been classified using deep region neural networks (De-RegNN) to detect and grad cataract automatically. The simulation results show optimal accuracy, precision, recall, F-1 score and specificity. It uses regular eye images to detect cataracts. Keywords: Cataract, machine learning, classification, IOT module, K-NeuNet, De-RegNN, prediction

1. Introduction:

One of the most common causes of blindness today, a cataract is defined as a clouding of the eye's lens that impairs vision. According to a recent study [1], there were 32.4 million blind persons and 191 million people with visual impairment in the world in 2010, with cataracts accounting for 33.4% of all cases of blindness and 18.4% of all cases of vision impairment. Additionally, the severity of the vision impairment increases with the length of time a patient has an untreated cataract [2]. Deep learning ideas, particularly the deep convolution neural network used for pattern identification, have recently been advancing quickly. It is possible to use this kind of structure to input image data in the form of pixels and output the appropriate categorization [3]. Our article is set up in the following way to better present our framework. The connected works are discussed in Section II. Details of our methodas well as training methods are provided in Section III. Accuracy of our method in comparison to previous approaches and its interpretability are presented in Section IV. Paper is discussed and concluded in Section V.

2. Related works:

The development of medical expert systems to automate diagnostic procedures has been the subject of extensive research [4]. For specific eye conditions, including dry eye disorders, refractive error, astigmatism, and the evolution of glaucomatous visual field abnormalities, textual and numerical data were employed in References [5,6]. The Electronic Medical Records and Genomics Network investigated cataract illness. In order to diagnose cataracts in patients who were not having surgery, ICD-9 (International Classification of Diseases) [7] codes and modern procedural terminology codes were used. Reference [8] also offers a current analysis of the techniques applicable to this kind of study and According to reference [9] [10], a gene network involving the determinants corresponding to the nodes was created to define disease expression.

3. Materials and methods:

Pre-training with K-NeuNet and the RDNN classifier make up the two halves of our cataract technique. We thoroughly introduce the two elements in this section. The proposed architecture has been given in figure 1.

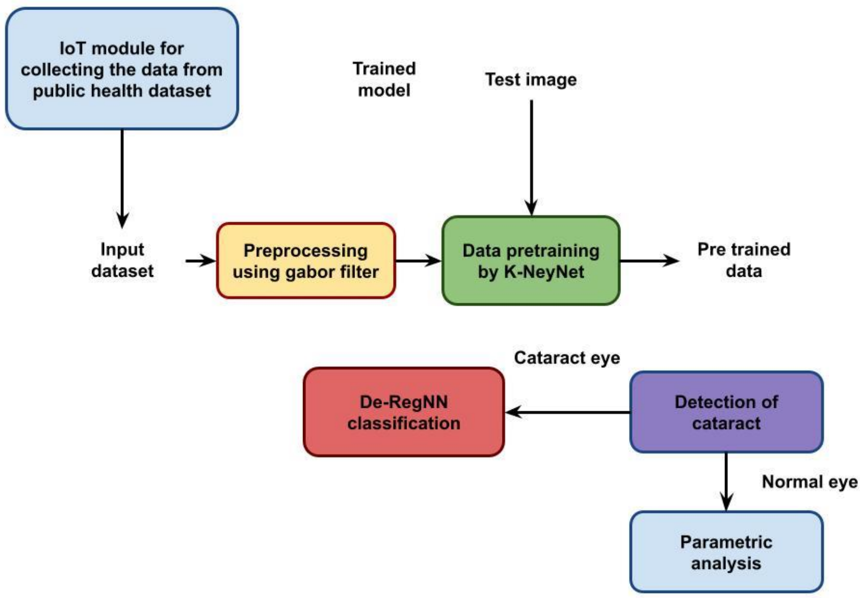

Figure 1- Proposed Architecture

3.1 Data-Preprocessing:

The input has undergone a Gabor filter pre-processing. The most significant features in the fundus picture, including the optic discs, retinal lesions, arteries, and aneurysms, have received much research. By evaluating the degree of clarity of fundus pictures, a cataract can be categorised into one of the four classifications listed above based on these characteristics: Moderate, severe, and non-cataractous.

3.2 Pre-training using K-NeuNetbased classification:

A technique for categorising objects based on nearby training samples in the feature space is the K-neural network algorithm. One of the simplest machine learning methods is the K-neural network algorithm. The sole steps involved in training this algorithm are storing the feature vectors and labels from the training images. The unlabelled question point is simply given the label of its k closest neighbours throughout the classification process.

$$d(x,y) = ||x-y|| = \sqrt{(x-y).(x-y)} = (\sum_{i=1}^{m}((x_i - y_i)^2))^{1/2} \quad (1)$$

where x and y are histograms in $X = R^m$

By pre-trained data, the detection of cataract eye has been carried out.When the eye is detected to be normal, its parameter has to be calculated. When cataract eye is detected, then De-Reg NN classification is carried out for better specificity and accuracy.

3.3 De-Reg NN classification:

In this case, W is made up of several p-by-p diagonal submatrices. Value of arbitrary entry wij in W can therefore be shown as in eq. (2)- (4):

$$w_{ij} = \begin{cases} qk_{l\times p+c} & if\ (c+k_l) \quad modp \equiv d \\ otherwise & \end{cases} \tag{2}$$

Below figure 2 shows cataract detection using De-RegNN.

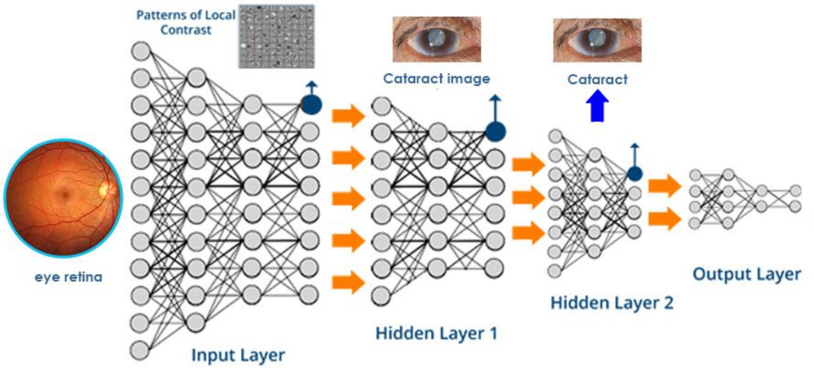

Figure 2- Cataract Detection using De-RegNN

$$\mathcal{F}(i,j,w,h) \leftarrow \mathcal{F}(i,jw,h) - \in \sum_{x=0}^{w_2}\sum_{y=0}^{h_2} \aleph(i,x-w,y-h) \times \frac{\partial J}{\partial Y(i,x,y)}, for\ any\ \mathcal{F}(i,x,w,h) \neq 0 \tag{3}$$

$$\frac{\partial J}{\partial X(i,j,x)} = \sum_{g=0}^{\frac{c_O}{\rho}-1}\sum_{w=0}^{w_1-1}\sum_{h=0}^{h_1-1}\mathcal{F}(i,j,w,h)\frac{\partial J}{\partial Y(i,x+w,y+h)} \tag{4}$$

4. Performance analysis:

This part begins with a description of the experiment setup, which includes the database, evaluation criteria, and implementation. then display and examine outcomes of experiment. E5-2609 CPU, 8GB RAM, Qudro K620 GPU, and Ubuntu 16 as operating system make up PC hardware configuration utilized for our suggested retina fundus picture classification with RDNN. Python's DL toolbox is used to implement the fundus picture categorization. According to the experimental findings in this section, verifying with at least 1606 samples provided generally applicable but not the most accurate results, whereas utilising fewer samples proved unreliable. Table-2shows comparison of accuracy score, F-1 score, AUC, precision, sensitivity, specificitybetween existing and proposed technique for cataract detection.

Table-1 Parametric comparison for proposed and existing techniques

Parameters	NLP	ICD-9	ICR	OCT	K-NeuNet_ De-RegNN
Accuracy Score	65	70	75	90	95
F1-Score	68	75	78	95	96
Precision	72	82	84	90	97
Sensitivity	76	84	88	93	95
Specificity	78	88	90	95	97

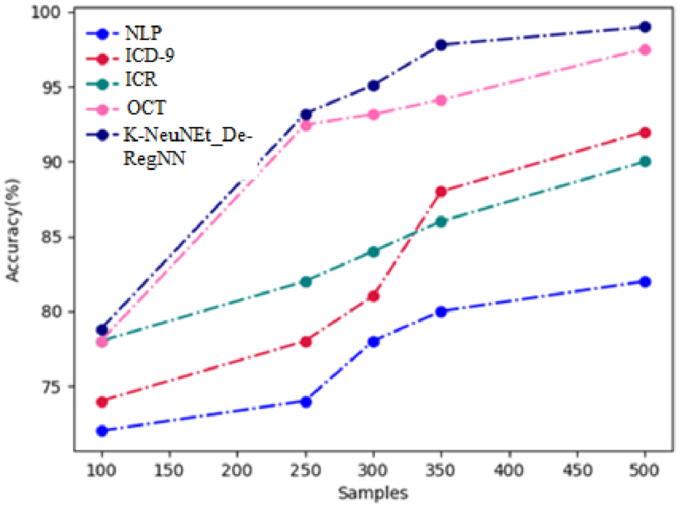

Figure-5 Comparison of Accuracy

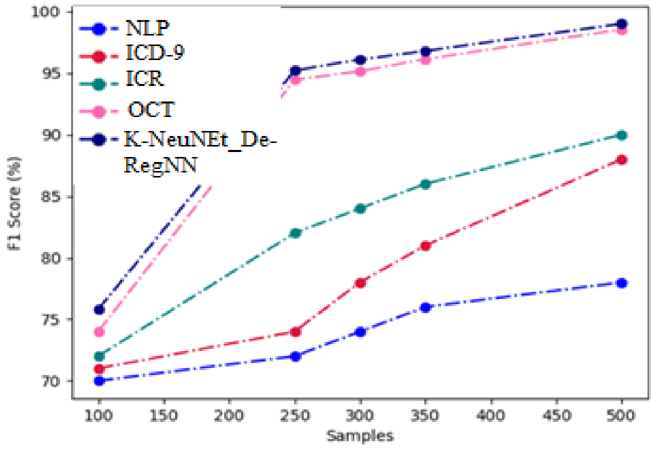

Figure-6 Comparison of F1- score

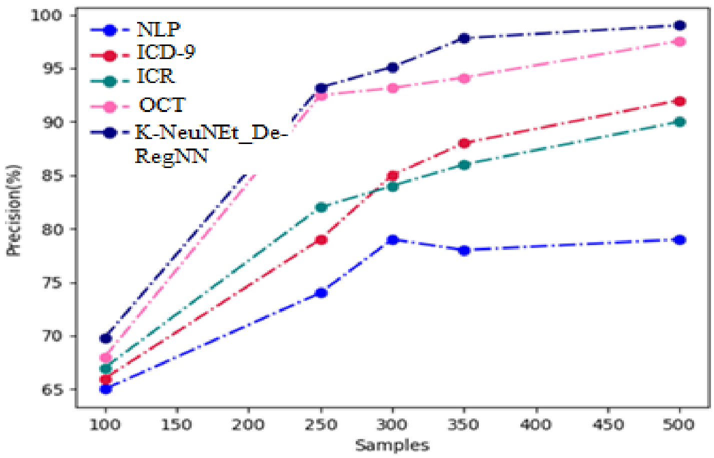

Figure-8 Comparison of Precision

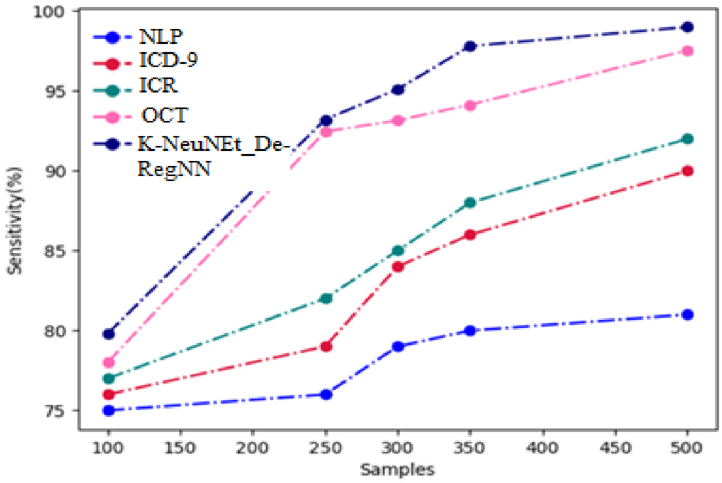

Figure-9 Comparison of Sensitivity

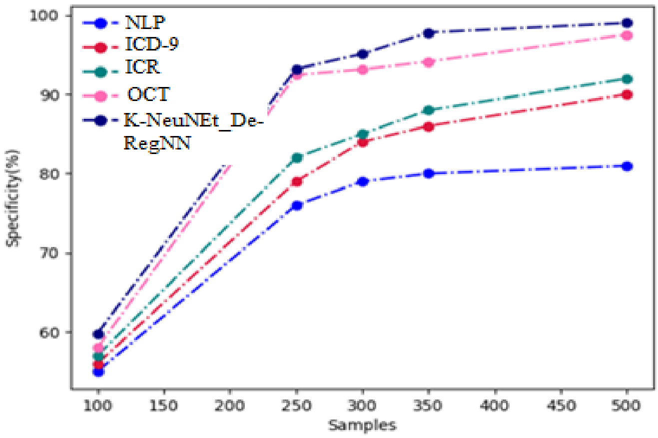

Figure-10 Comparison of Specificity

The figure 5,6,7,8, 9 and 10 shows comparison of accuracy, F1 score, AUC, precision, sensitivity and specificity between proposed and existing techniques.

5. Conclusion:

By training and testing on input photos, the suggested method in this study using K-NeuNet De-RegNN is capable of breaking records in the difficult cataract identification task. In terms of accuracy and specificity, our method is superior to the state-of-the-art. After K-pre-training, NeuNet's which significantly aids De-RegNN classification, the retinal pictures were used to get over interference of local uneven illumination as well as reflection of the eyes. De-RegNN effectively and automatically extracts the discriminative characteristics that define high-level information as opposed to doing so manually. This method has been shown to be quite useful in the early detection and diagnosis of cataracts and has a great deal of promise for use in other eye illnesses.

References:

[1] Yu, Felix, et al. "Assessment of automated identification of phases in videos of cataract surgery using machine learning and deep learning techniques." *JAMA network open* 2.4 (2019): e191860-e191860.

[2] Sramka, Martin, et al. "Improving clinical refractive results of cataract surgery by machine learning." *PeerJ* 7 (2019): e7202.

[3] SV, Mahesh Kumar, and R. Gunasundari. "Computer-aided diagnosis of anterior segment eye abnormalities using visible wavelength image analysis based machine learning." *Journal of medical systems* 42.7 (2018): 1-12.

[4] Sramka, Martin, et al. "Improving clinical refractive results of cataract surgery by machine learning." *PeerJ* 7 (2019): e7202.

[5] Lin, Haotian, et al. "Diagnostic efficacy and therapeutic decision-making capacity of an artificial intelligence platform for childhood cataracts in eye clinics: a multicentre randomized controlled trial." *EClinicalMedicine* 9 (2019): 52-59.

[6] Zhang, Linglin, et al. "Automatic cataract detection and grading using deep convolutional neural network." *2017 IEEE 14th International Conference on Networking, Sensing and Control (ICNSC)*. IEEE, 2017.

[7] De Fauw, Jeffrey, et al. "Clinically applicable deep learning for diagnosis and referral in retinal disease." *Nature medicine* 24.9 (2018): 1342-1350.

[8] Xu, C., Zhu, X., He, W., Lu, Y., He, X., Shang, Z., ...& Li, X. (2019, October). Fully deep learning for slit-lamp photo based nuclear cataract grading. In *International Conference on Medical Image Computing and Computer-Assisted Intervention* (pp. 513-521). Springer, Cham.

[9] Pratap, T., &Kokil, P. (2019). Computer-aided diagnosis of cataract using deep transfer learning. *Biomedical Signal Processing and Control*, *53*, 101533.

[10] Yusuf, M., Theophilous, S., Adejoke, J., & Hassan, A. B. (2019, October). Web-based cataract detection system using deep convolutional neural network. In *2019 2nd International Conference of the IEEE Nigeria Computer Chapter (NigeriaComputConf)* (pp. 1-7). IEEE.