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Research paper

General Awareness and Knowledge about Glaucoma Cataracts for Diabetic

(Images Analysis for glaucoma)

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Abstract

Horizontals and verticals cups to discs percentages are the most crucial limitations used clinically to find glaucoma or observer its growth and are physically calculated from pictures of retinal fundus of the optic nerves heads. Appointed to the rarity of the glaucoma specialists as well as the rising of glaucoma's population, an automatically analyzed horizontal and vertical cup to disc ratios (HCDRs and VCDRs, resp.) may be valuable for glaucoma monitoring. We description one algorithm to determine the HCDRs and VCDRs. This algorithms, amount and pictures techniques were technologically advanced for segmenting the disc, though thresholding operating Type-II fuzzy method was progressed for slices of the cup. The outcomes from the algorithms were confirmed using the guide of images markings from a dataset of glaucomatous images (retinal fundus images for glaucoma analysis (RIGA dataset)) by five ophthalmologists. The algorithm's accuracy for HCDRs and VCDRs merged was 65.3 %. Simply the accuracy of guide markings by one ophthalmologist was higher than the algorithm's accuracy. The algorithm's best understanding was with markings by ophthalmologist number 1 in 130 images (32.7%) of the whole examined images. Flow chart for images analyzed were add in this paper as reference.

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1. Introduction

With the world population increasing dramatically, the number of people with glaucoma or suspected glaucoma also increased. Therefore, there is a greater need for proper diagnosis and effective control of glaucoma. Accurate diagnosis of glaucoma requires three different sets of examinations [1]

1. Calculation of the intraocular pressure (IOP),
2. Calculation of the visual field,
3. Calculation of the optic nerve head.

Since both high tension glaucoma and natural glaucoma tension may or may not increase the IOP, the IOP itself is not a sufficient diagnostic or diagnostic method. Visual field testing, on the other hand, requires special equipment, which is usually only available in tertiary care hospitals equipped with a bottom camera, peripheral devices, and possibly optical coherence tomography CT. Examination of the optic nerve head (cup to disk ratio) is a valuable way to diagnose glaucoma structurally. The main open-angle glaucoma causes progressive optic neuropathy and its development is associated with the loss of tissue at the neuroretinal edge of the optical disc which will result in an increase in the visual cup size. The pattern of loss of neuroretinal space and enlargement of the cup may take the form of axial or diffuse change, or both. Focal change, with the loss of the physiological shape of the neuroretinal edge, is determined by careful clinical examination. Diffuse change, while maintaining physiological edge shape, is more difficult to determine. It is in these cases that the quantitative measurement of the neuroretinal edge area or cup size is useful. Methods have been described to estimate the area of the neuroretinal edge during ophthalmoscopic examination, but there are many measurements, calculations or additional equipment required. Clinical assessment of cup size using lamb slit or simple imaging modalities such as bottom images is a significant clinical parameter and remains the simplest and most frequently used optical disc assessment in diagnosis and follow-up of the development of suspected glaucoma. The size of the cup is usually estimated relative to the size of the disc and is given as a ratio of the vertical and horizontal diameter of the cup to the vertical and horizontal diameter of the disk based on Garway Heath et al. Thus, the automatic system of the optic nerve head examination is very useful. In a recent paper, Almazero et al. Review literature reviews on glaucoma treatment [2].

This paper yields results from horizontal and vertical cup calculations for disk ratios using our pre-optical disc and enter the cup algorithms. The algorithms were tested using the RIGA data set. The rest of the paper is organized as follows. The research methodology is explained in Section 2. The results are presented in Section 3. We discuss the results and end in Section 4.

2. Methodology

RIGA data were collected to facilitate research on computer-assisted diagnosis of glaucoma. The data consists of 130 color-coded images obtained from the Al Magrabi Eye Center in Baghdad, Iraq. It was obtained in 2017-2018 using Canon's Nonmydriatic CR2 digital retina camera (less resolution images). The images were obtained between December 2017 to January 2018 using the TOPCON TRC 50DX mydriatic eye retinal camera. Image sizes are pixels. The pictures were manually recorded by 6 ophthalmologists individually. Each one notated the limits of the disk and cup manually by using an accurate pen for Microsoft Surface Pro 3 with a 12 inch high resolution screen (pixels). Six criteria were calculated for the index marks in order to use them to evaluate algorithms, namely disk area, central disk, cup area, centipede cup, vertical cup to disk ratio, and horizontal cup to disk ratio [3] [4].

3. Results

3.1 Horizontal Cup to Disc Ratio (HCDR)

To calculate the HCDR using the manual marking of the disc and cup, the furthest two pixels horizontally were considered for the disc and cup separately, and then their ratio was calculated. The same procedure was followed for automatic calculation of HCDR after segmenting the disc and cup. Three parameters' outliers were considered in order to filter the images for the HCDR:

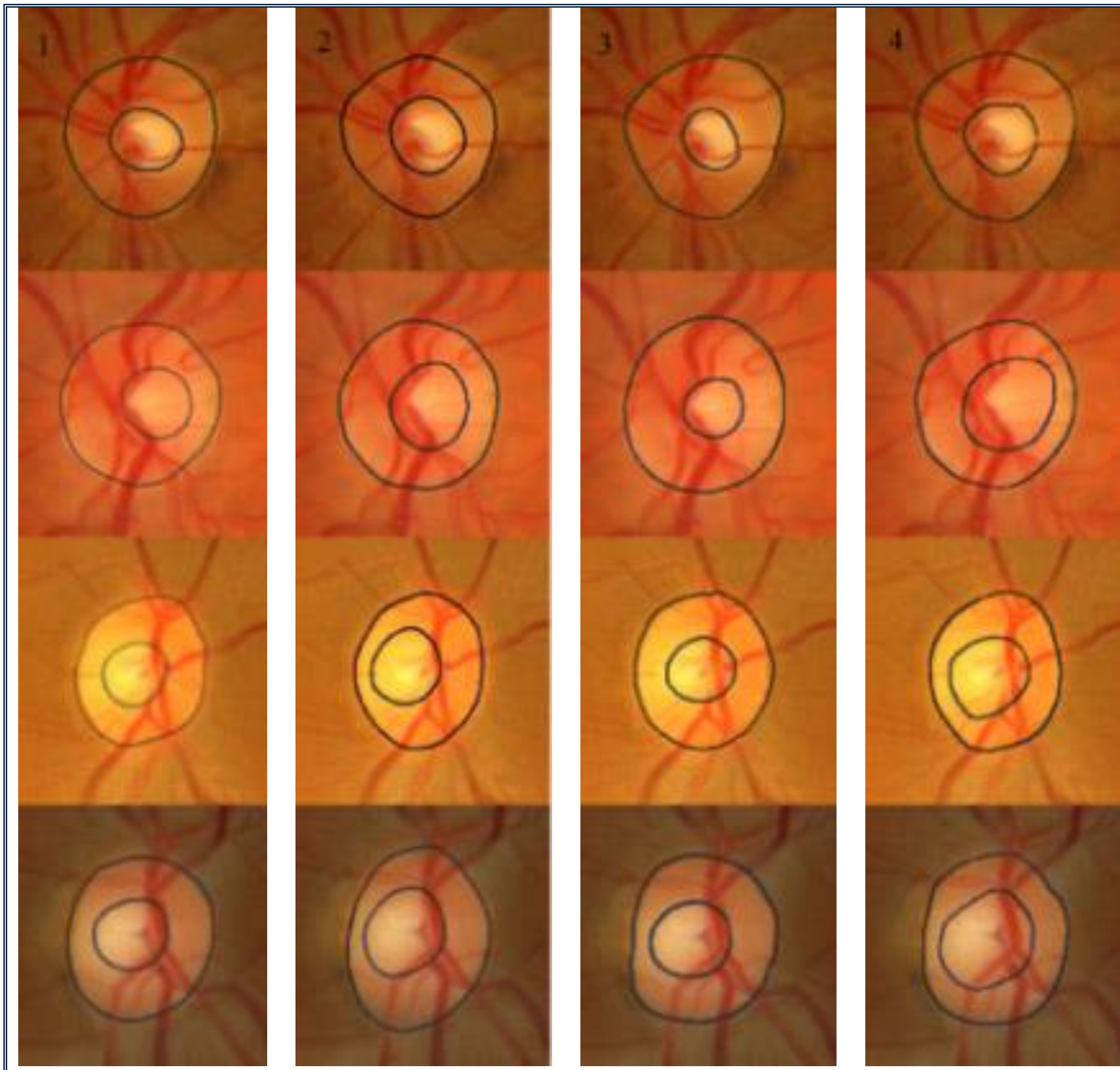
1. The disc outliers (area and centroid),
2. The cup outliers (area and centroid)
3. The HCDR outliers.

Those parameters were chosen in order to calculate accuracy between the six ophthalmologists; then the filtered images are used to evaluate any developed algorithm. Firstly, the standard deviation (SD) between the 6 ophthalmologists for every fundus image was calculated for the disc (area and centroid) and cup (area and centroid) separately. Secondly, a mean SD was calculated for every parameter which will be the judge between the six ophthalmologists for every parameter, that is, deciding whether there is an outlier (when SD of the image > mean SD) between the ophthalmologists in marking of the disc or cup boundaries by testing the six manual markings one by one. The mean and standard deviation for all the disc and cup parameters were different based on the different size of the images, which will affect the size of the disc and cup for every images dataset.

Thirdly, the mean SD for the HCDR was 0.075. Any manual marking making the HCDR SD more than 0.075 was considered as an outlier and was eliminated from further analysis. The same was true for the automated system. Thus, many images were eliminated. Removing the outliers obviously affects the number of agreements in markings done by the ophthalmologists as well as the algorithm. Therefore, three parameters were considered when deciding whether an image could be used for evaluation of the algorithm. If there were at least three outliers for a certain parameter, for example, disc area, for an image, then the image was eliminated from evaluating the algorithm. While based on the statistical analysis if there were three outliers from different parameters for one image, for example, one for disc centroid, one for cup area, and one for HCDR, then the image was not eliminated. However, if there were four outliers with two of them on the same parameter, for example, two outliers for the disc area, one for the cup area and one for the HCDR, then the image was eliminated. That will be including all the images either normal or glaucomatous. Filtering the images based on the aforementioned method, the verity of the manual marking of the disc and cup boundaries among the 6 ophthalmologists will be considered as unclear diagnosis whether for normal or glaucomatous images which will be leading to removing the outlier images from evaluating the new algorithm.

Figure 1 (A) bad fragmentation of HCDR

Oph1	Oph2	Oph3	Oph4



For the first picture, represented in the first row, recorded by the number of six ophthalmologist have been eliminated because of the disk space that affected the HCDR, while the algorithm gave poor results due to cup size.
In the second picture, represented in the second row, signs were eliminated by ophthalmologists numbers four and six for the presence of the cup area and the middle point, respectively. The algorithm gave bad results due to bad disk fragmentation.
In the third picture, the signs of three ophthalmologists were eliminated for various reasons. Thus, this image is not considered in the algorithm evaluation.
In the fourth picture, markers were eliminated by four and six eye doctors due to the cup and central area of the disc, respectively.

Figure 1 (B) bad fragmentation of HCDR

Oph5 Oph6 Oph Algorithm

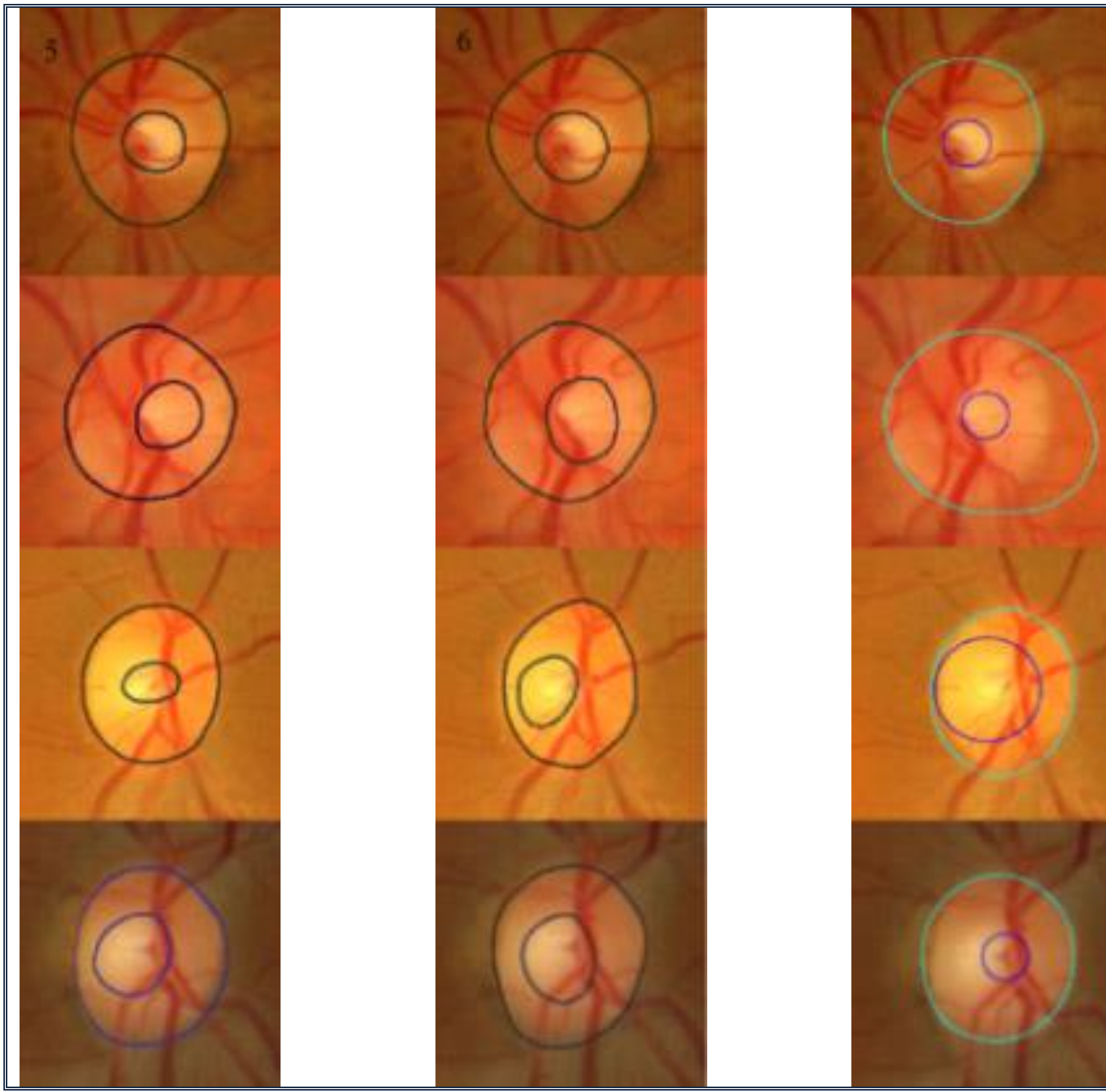


Figure 1 (A,B) shows the results show a bad fragmentation of the HCDR for four different images with each different case. For the first picture, represented in the first row, recorded by the number of six ophthalmologist have been eliminated because of the disk space that affected the HCDR, while the algorithm gave poor results due to cup size. In the second picture, represented in the second row, signs were eliminated by ophthalmologists numbers four and six for the presence of the cup area and the middle point, respectively. The algorithm gave bad results due to bad disk fragmentation. In the third picture, the signs of three ophthalmologists were eliminated for various reasons. Thus, this image is not considered in the algorithm evaluation. In the fourth picture, markers were eliminated by four and six eye doctors due to the cup and central area of the disc, respectively. Algorithm has given a bad result due to poor cup area fragmentation.

Figure 2 Good fragmentation of HCDR

Oph1	Oph2	Oph3	Oph4	Oph5	Oph6	Oph Algor

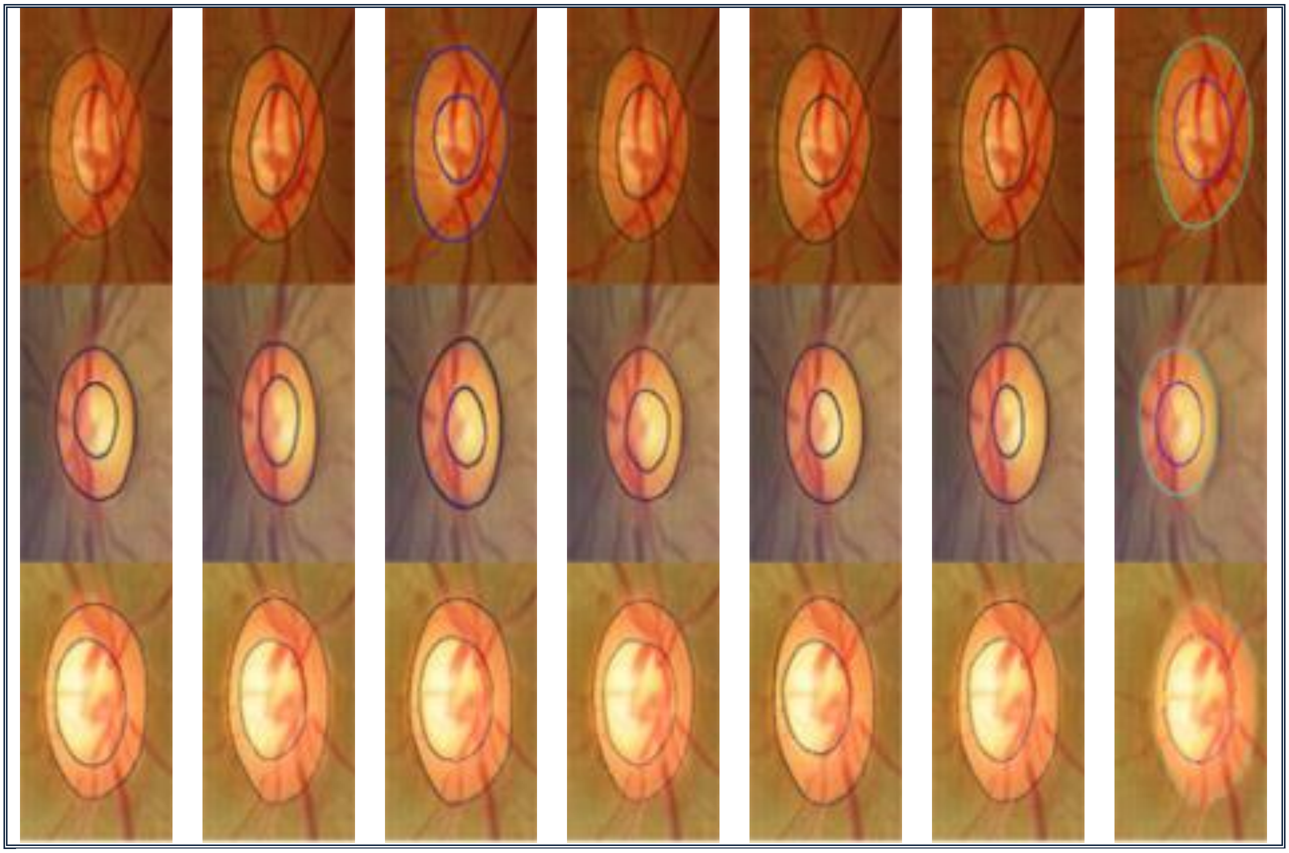


Figure 2 shows examples of good fragmentation results for HCDR. In these images, the results yielded a good algorithm for the disk, cup, and HCDR of the data where the mean SD 0.03 was 0.025 and when the results of the algorithm were incorporated. Furthermore, for these evidence the HCDR was given by the 0.68 algorithm, while 0.69, 0.66, 0.70, 0.73, 0.68 and 0.66 were reported to be in the number of ophthalmologists 1-6, respectively.

Table 1 statistics of HCDR

	Oph1	Oph2	Oph3	Oph4	Oph5	Oph6	Oph Algo
Pictures Amount	130	130	130	130	130	130	130
No. of Lack Pictures	50	41	53	44	49	51	48
Not localized	6	6	6	6	6	6	6
Pictures Tests	74	83	71	80	75	73	76
No. of accuracy Pictures	53	63	37	52	49	49	58
Percentage of accuracy	71.4	76.4	51.8	65.3	64.8	67.2	76

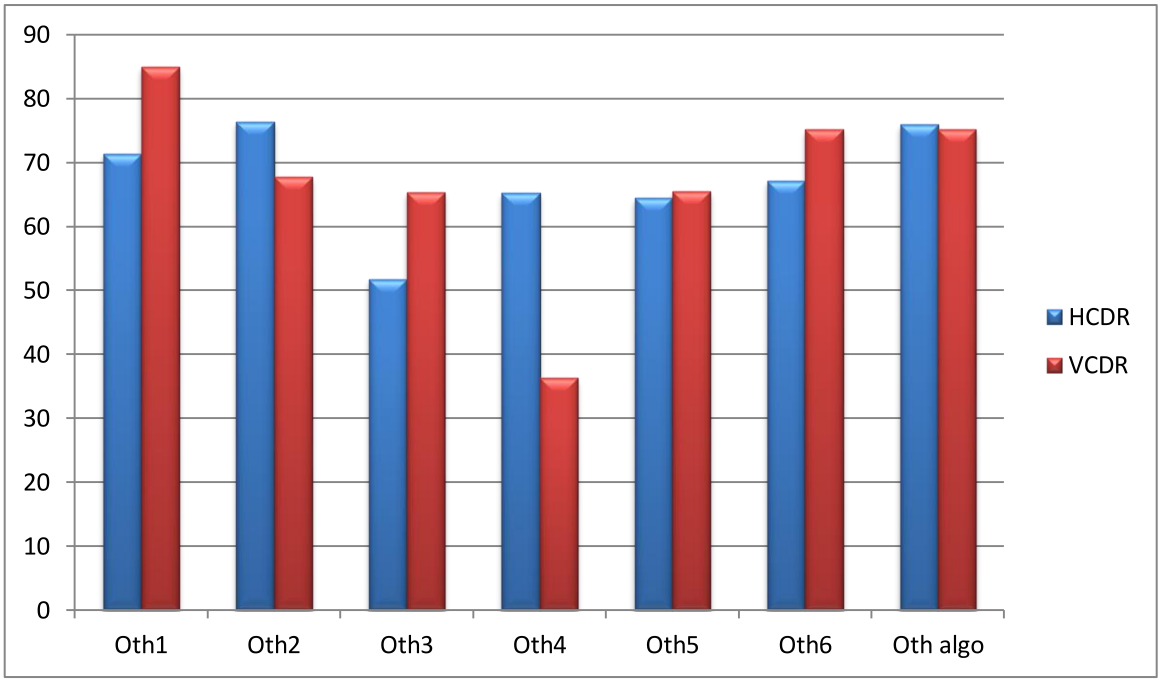
Fewer images from a Al Magrabi group were used to evaluate the algorithm. As shown in TABLE1, a total of 130 images were used that were not localized 6 images and 41-53 images were canceled due to extreme values in manual markings of disk, cup, or HCDR. For this photo collection, Ophthalmologist had number two on the best performance, testing 51 images in total with 39 image resolution. The performance of the algorithm was the second best. The total number of images tested by the image algorithm was 46. Most of the extreme values that resulted in the elimination of images were due to errors in ophthalmologists' scores of six, three, and five digits.

4. Discussion

The goal was to have an automatic system capable of fragmentation the disk and the border cup exactly as it was done manually. The ROI was a pre-processing step introduced to allow handling of a small portion of the image rather than the entire image. This was done by applying a mysterious interval based on the second type of entropy scheme along with the differential evolution of the optical disc locator. The multi-level image segmentation was a way to divide the image into different objects in order to find the brightest image object, which was present in the visual cup. In terms of the main process, optical disc fragmentation was introduced first by applying the active contour that is performed by the level group function after in fining the blood vessels. Has been imputing to remove obstacles that may be present at the group level due to changes in vascular strength. A double-level group was applied with more processing for low-quality images (with nonmetric). On the other hand, the cup was split in two stages. In the main stage, disk fragmentation is not considered. Blood vessels were extracted in order to detect vessel vascularity to help detect the limits of the trophy. The time interval chart based on the two innovative periods of the second type and differential development was applied again to the translated image to reveal the optical cup boundary strength. Then the conversion was applied in order to round the cup. In the second stage, disk fragmentation was shared in order to improve the accuracy of the central cup by developing two other functions of X and Y coordinates [5].

After examining the images, only the segmented images were successfully included in relations of disk and cup in the HCDR calculations. The inspection process allowed including the individual images that met the conditions for the three parameters of disk, cup, and HCDR. The identical process was frequent for VCDR. Thus, in the ending examination only the images that encountered the conditions of the disk, the cup, were considered HCDR, and VCDR ([6],[7]).

As shown in Figure3, the algorithm was roughly the same number of neatly segmented pictures for every tests of (V&HCDRs) as the amount three eye doctors. The four ophthalmologists had more acceptable images of VCDR due to lower blood vessels in these two sides (upper and lower). However, the accepted images of HCDR were less correct due to the presence of blood vessels that covered the boundaries of the cup. One eye doctor had the same number of acceptable images for VCDR and HCDR as the algorithm. Therefore, the second best algorithm for teaching HCDR and the fourth best to teach VCDR in terms of accuracy ([8],[9]).



We have shown that there is a significant disparity between ophthalmologists in celebrating the bottom images of Almazroa et al. Many factors, including fatigue, time of day, concentration, can contribute to variability in human marks. Therefore, it is important to have an "objective" way to calculate these criteria of clinical interest. Future business should aim to develop a smart phone application that can be used in conjunction with a bottom lens facility to capture and process bottom images. The application can be used to visually examine the structure of the nerve head and help diagnose glaucoma ([10],[11]).

Such a system would be of great benefit, especially in countries where access to higher or specialized centers for glaucoma is not available or difficult to develop. This system would be an integral part of telemedicine. Initial diagnosis is done using a smartphone application and once the trophy for the disk ratio is found to be an indication of glaucoma disaster, the university hospital or specialist is automatically notified ([12],[13]).

Applying the smartphone will also allow the patient to take pictures of the bottom at home in order to closely monitor and accurately progress / remission of the disease, as well as follow-up of the treatments. The graphical user interface that allows manual modification of the algorithm (especially for the cup) should also be considered for future work [14].

This characteristic will allow the eye doctor to bring the cup automatically segmented into any position he / she considers to be most appropriate on the basis of his / her clinical experience.

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