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FULL PAPER

Iraqi Retinal Fundus Diabetic Retinopathy Dataset (IRFDRD)

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Abstract

Diabetic Retinopathy (DR) is a leading cause of vision loss globally. Early diagnosis is crucial for preventing blindness. This research utilizes fundus camera images of the retina to analyze DR. The dataset is classified into five categories: healthy, mild, moderate, severe, and proliferative DR. Infrared fundus reflectance (IRFDR) images have shown promising outcomes when employed with deep learning algorithms

Keywords: DR, IRFDRD, deep learning, DR classification, DR detection.

Specification Table

Subject area	Medicine and ophthalmology
More specific subject area	Retinal screening
Types of data	Images
Data format	JPEG
Experimental factors	All images are classified as healthy, mild, moderate, sever, and proliferative DR.
Experimental key finding	When fundus images are used for training of deep learning models, they show fast and accurate classification of DR.
Data source location	Al-Nahrain University/ College of Engineering/ Biomedical Engineering Department
Data accessibility	https://github.com/noor-aliz810/IRFDRD.git

Value of the Data

- Fundus camera is mostly used in DR detection. Moreover, it is safe retinal imaging technique.
- IRFDRD can be used to train deep learning models that can classify early signs of DR.
- The data is comprehensive, containing DR severity stages (healthy, mild, moderate, severe, and proliferative DR).
- This dataset is- to our knowledge- the first Iraqi dataset publicly available.
- Researcher with interest in detection and classification of DR can use IRFDRD images, combine them with others' datasets, and resolve them for further perspectives.

Background: Diabetes Mellitus is an endocrine condition caused by elevated plasma glucose level due to abnormal insulin secretion. Diabetes Mellitus is a progressive disease that cause many complications such as retinopathy, nephropathy, neuropathy, and autonomic dysfunction (Reichel et al., 2015). Diabetic Retinopathy (DR) is one of the important complications, if it diagnosed earlier, severe loss of vision can be avoided. Therefore, it is essential that patient with diabetes undergo routine screenings for DR with a suitable diabetic eye screening tool. DR pathogenesis occurred from either microvascular occlusion or microvascular leakage affecting the retinal precapillary arterioles, capillaries, and venules. According to statistical research, DR affects 80% of people with diabetes who struggle with the disease for 15 to 20 years (Wilkinson, 2003). DR is the primary cause of blindness and visual impairment worldwide, and its rate is steadily rising as a result of an increase in the number of patients with Diabetes Mellitus (Daniel Shu Wei Ting et al., 2015 and Dolly Das et al., 2022). The diagnosis of DR involves an eye examination through a range of features that aim to detect microvascular damages in the retina such as; microaneurysms, haemorrhages, hard exudates, soft exudates (cotton wool spots), neovascularisation, and macular oedema, as shown in Figure (1). Diabetic retinopathy is classified into four stages according to its severity: mild, moderate, severe and proliferative Diabetic Retinopathy (Daniel Shu Wei Ting et al., 2015).

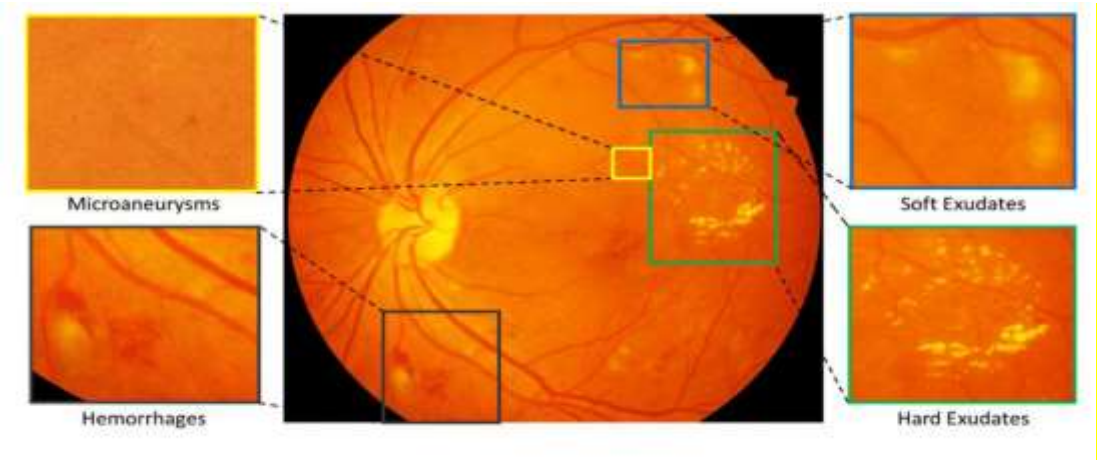

Figure (1) A color fundus image showing various retinal abnormalities linked to diabetic retinopathy. larger sections showing the presence of hard exudates, hemorrhages, soft exudates, and microaneurysms (Wilkinson, 2015).

Dataset Description

The dataset in this study comprises fundus images of the retina collected from the main center of ophthalmology in Iraq. The IRFDRD is classified into five DR classes: healthy, mild, moderate, severe, and PDR, stored in JPEG format with a separate folder for each class. Each folder contained the fundus images, the total numbers of each group are shown in Table (2). These classes were very useful in facilitating the management of the data for training by deep learning algorithm.

Method

This section consisted of retinal imaging system to observe the retinal disease for diagnostic operation at first. Then, a full description of the collected IRFDRD that have been used to evaluate the performance of the algorithms used for diagnosis or classification of eye diseases especially diabetic retinopathy.

1. Retinal imaging system:

Professional skill, a large cost, and a long time are required for the examination of the retina in conventional ways to detect DR, depending on the severity of the condition. In order to provide patients with appropriate treatment, ophthalmologists must examine each patient individually to assess their retinal health. A painless and non-invasive method of screening the retina is retinal fundus imaging. All Iraqi patients with suspected DR visit the major eye center in Iraq, where the fundus photos in the database were obtained. The Huvitz, shown in Figure (2), is an optical coherence tomography equipped with fundus camera that has become a key instrument for diagnosis of posterior eye segment diseases. The technology produces exceptional quality retinal images with enhanced color, resolution, and contrast, significantly aiding in clinical diagnosis and research.

Figure (2) Huvitz OCT.

Fast capture, small pupil mode, silent operation, low flash intensity and automated flicker detection, all contribute to the best images with specification of fundus camera shown in Table (1).

Table (1) Specification of Huvitz Fundus Camera.

Fundus camera	Type	Non-mydriatic fundus camera
	Resolution	60line pair/mm or more (center) 40line pair/mm or more (middle) 25line pair/mm or more (periphery)
	Angle of view	45°
	Camera	Built-in 12M pixel, color or built- in 20M pixel, color
	Minimum pupil diameter	4 mm (normal mode), 3.3 mm (small pupil mode)
	Flash light	White light, 10 levels
	Pixel pitch at fundus	3.69 um (20M pixel color), 4.63um (12M pixel color)
	Capture mode	Single, stereo, wide field panorama

2. IRFDRD:

The IRFDRD was collected from the Iraqi patients at the main ophthalmology teaching center in Iraq. Patients with DR were admitted to the center from all Iraqi cities (https://github.com/noor-aliz810/IRFDRD.git, https://doi.org/10.5281/zenodo.12552326). The majority of the patients included in the dataset had experienced mydriasis before the photos were taken. One drop of tropicamide at a concentration of 0.5% was used to dilate the pupils in order to cause mydriasis. Figure (3) displays a sample image from the IRFDRD that shows the location of the optic disc, fovea center, OD (retinal image on the right), OS (retinal image on the left), and other necessary details.

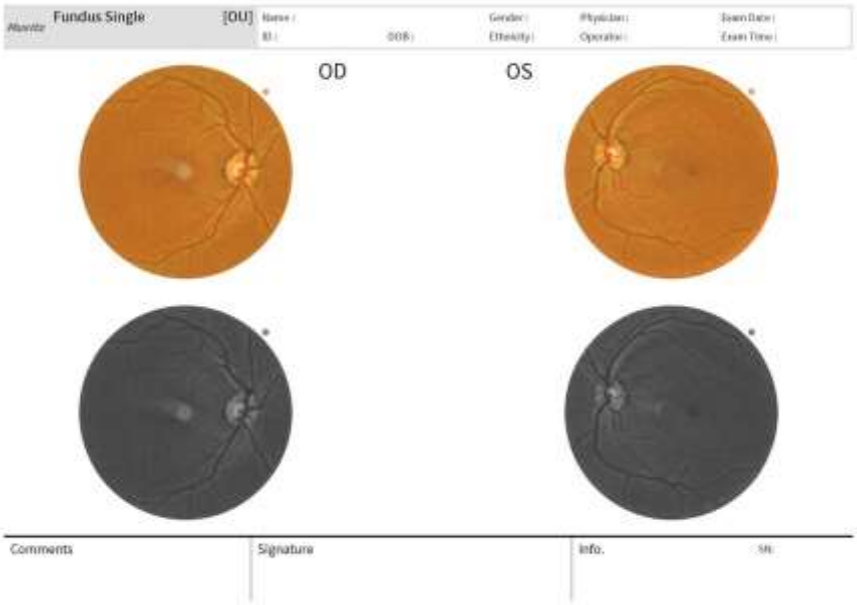

Figure (3) Sample image from the IRFDRD illustrating the OD (retinal image on the right), OS (retinal image on the left), optic disc and fovea center location.

This dataset consisted of 700 retinal fundus images that were collected from 350 subject. The mean age of the subjects was 45 years, with a standard deviation of 27 years and labeled under the supervision of specialized ophthalmologists in the college of medicine/ Baghdad University. Then, the data were classified according to (EDTRS) standards shown in Figure 4 in to five stages depending on the severity level of DR.

Types of DR in years	0 Normal eye	3-5 Mild DR	5-10 Moderate DR	10-15 Sever DR	More than 15 PDR
Severity level	non- proliferative DR				Proliferative DR
Fundus changes					
Retinal changes according to ETDRS severity levels	No retinopathy	Few small microaneurysms only	Microaneurysms, exudates, venous beading. IRMA	More than 20 intraretinal hemorrhage each of 4Q, venous beading in 2Q, Irma in 1Q, no signs of PDR(4:2:1 rule)	Neovasculization , vitreous/ preretinal hemorrhage

Figure (4): Diabetic retinopathy progression. This Figure describes the classification stages, time duration of each stage with the fundus and retinal changes according to the severity level of DR.

The first stage contained 153 fundas images diagnosed as healthy, the second stage included 59 images as mild, the third stage involved 304 images classed as moderate, the fourth stage consisted of 99 images as severe cases, and the last class was comprised of 85 images as PDR as shown in Table (2). The collected images were stored in the hospital server and could be used for teaching and research

purpose after obtaining ethical permission. The images captured with resolution of 3507 × 2480 pixels and were saved in jpeg format. 440 KB is the size of each image. These images were cropped using MATLAB program to obtain an individual left and right fundus image as shown in Figure (5). Therefore, the total number of the right side (OD) and left side (OS) retinal fundus images are 700 images (350 images for each side). Sample of the labelled dataset is shown in Figure (6)

Table (2) The five classes of DR and the number of images in each class.

Cases	The quantity of images
Healthy (Normal)	403
Mild	59
Moderate	304
Sever	99
PDR	85

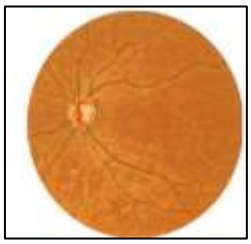

Figure (5) OS Cropped Retinal Fundus Image from IRFDRD.

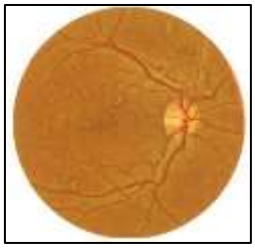

Figure (6) OD Cropped Retinal Fundus Image from IRFDRD.

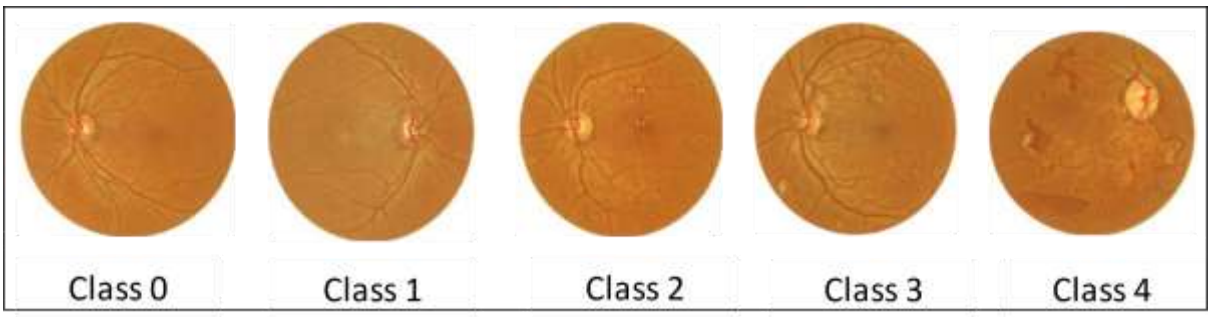

Figure (7)

Sample of the IRFDRD images with DR shows the main classification grades: 0 class represents the normal or healthy image; 1 class denotes the mild stage of DR; class2 represents the moderate stage; class3 shows the severe non proliferative DR and class 4 shows then last PDR stage.

Ethical Consideration

This research adhered to ethical guidelines, including the 1964 Helsinki Declaration and our institution's research committee standards. The Ministry of Health granted ethical approval for the use of anonymized patient data from Iraqi sources.

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Conflict of Interest

The authors confirm that no competing financial interests or personal relationships exist that could have been perceived to have influenced the research reported herein.

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