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Edgy salient local binary patterns in inter-plane relationship for image retrieval in Diabetic Retinopathy

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Abstract

In this paper, a novel approach for content based image retrieval (CBIR) in diabetic retinopathy (DR) is proposed. The concept of salient point selection and inter-plane relationship technique is used. Salient points are selected from edgy image and later using inter-planer relationship, Local Binary Patterns (LBPs) are calculated using the salient point as a center pixel. Our approach enhanced the results as we used color features in combination with LBP features. Experimentation is carried out on MESSIDOR database of 1200 retinal images, proposed approach has average precision of 57.82% as compared to the earlier approach whose average precision is 53.70%.

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Keywords: Content-Based image retrieval (CBIR); Diabetic Retinopathy (DR); Edgy Salient points Local Binary Patterns (LBPs).

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1. Introduction

1.1. Motivation

Diabetic patients are generally vulnerable to a severe disease known as Diabetic retinopathy (DR) which is associated with the retina of the patients and make them prone to complete blindness if untreated in time. Diabetes patients should go for a regular checkup and detect DR at initial stage only. DR grows up step by step and reaches to a very severe stage from where it is nearly impossible to cure the retina. According to International diabetes federation (IDF) in 2015 there were 415 million people with diabetes i.e. one in every 11 adults. In 2040 the number predicted to be 642 million i.e. one in every 10 adults. 3/4th of the diabetes population belong to low and middle income countries. One in two adults with diabetes is undiagnosed. There has been a rapid growth in number of diabetes patients per ophthalmologist ratio in recent years which will grow further. So, soon there will be deficiency of expert doctors to diagnose the enormous number of patients.

Nowadays content based image retrieval (CBIR) techniques have proved themselves very useful in early detection of retinal diseases. The fundus images acquired from different diabetic patients are very useful data for the analysis of retinal diseases using image processing techniques. The CBIR process comprises mainly of two stages. First stage is feature extraction and second is query matching. In feature extraction, features such as color, shape and texture of image are extracted and a feature vector is formed. Feature vector is an optimized form of an image. The second process in CBIR is query matching based on similarity measurement which uses the distance of the query from each image in database to find the closest image.

1.2. State of the Art

Staal et al. [1] proposed a system for segmentation of retinal images which extracts image ridges, and these extracted ridges are classified using K-NN classifier. Mendonca et al. [2] did segmentation of retinal blood vessels by extracting vessel centerlines, later they used Iterative region growing method that integrates all the binary images resulting from vessel width dependent morphological filters. Martinez-Perez et al. [3] proposed a method to segment retinal blood vessels based upon multi-scale feature extraction. They used first and second spatial derivatives of intensity image. Lamard et al. [4] have proposed a method for CBIR that used adapted wavelet and weighted distance between signatures. These weighted distances are obtained from computing signature distance between the query and database image. Ricci et al. [5] did segmentation of retinal images using a basic line detector to construct feature vector and used support vector machine for feature classification. Tobin et al. [6] proposed a method to retrieve retinal images from a retinal image database in which they estimated the posterior probability of K-NN. They made use of weighted summation of the similarity between query vector and neighboring indexes. Quellec et al. [8] used optimized wavelet transform for content based image retrieval. They used generic indexing of database images which after applying wavelet transform generate a signature for each image. Then they defined a distance measure to compare two such image signatures to find most similar images in database for a query image submitted by a physician. Baby et al. [13] have proposed a method for content based image retrieval using dual-tree complex wavelet transform (DT-CWT) along with generalized Gaussian model (GGD) and kulback-leibler divergence (KLD) measurement. Naguib et al. [14] proposed a method for content based image retrieval of diabetic macular edema (DME) Images. In which they divided the macula into three concentric regions then they used texture discontinuities of these regions to represent lesions in retina. The distance measure gives higher weights to lesions closer to the fovea to reflect the severity of DME. Sivakamasundari et al. [16] proposed a CBIR method in which segmentation is done using kirsch template based edge detection and texture features are calculated. Euclidian distance method is used to carry out similarity matching of the query image with the images in database. Rosas-Romero et al. [18] proposed a new method for detection of microaneurysms. They applied bottom-hat transform to remove reddish regions. Then they applied hit-or-miss transform to remove blood vessels from RoIs.

Most of the work done in Diabetic retinopathy is for segmentation and classification. Very little work is done in CBIR and the retrieval results are not much satisfactory. This is because it is very much difficult to differentiate