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Cluster Based Method to Spot Hard Exudates in Moderate Stage of Non-Proliferative Diabetic Retinopathy

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ABSTRACT

Diabetic retinopathy (DR) is a diabetes related eye disease which occurs when blood vessels in the retina become swelled and leaks fluid which ultimately leads to vision loss. Several image processing techniques including Image Enhancement, Segmentation, Image Fusion, Morphology, Classification, and registration has been developed for the early detection of DR on the basis of features such as blood vessels, exudes, hemorrhages, and microaneurysms. The damage caused by diabetic retinopathy can be prevented by the early detection of microaneurysms, exudates and hemorrhages in the retina. Hard Exudates are medical sign of DR in fundus image [1]. Presence of exudates described the levels of DR. Timely recognition of exudates can reduce the risks of loss of sight. The proposed paper has discussed about the identification of exudates using K-means clustering in digital image of fundus using different preprocessing and feature extraction techniques.

Keywords: Diabetic Retinopathy, Hard Exudates, Fundus Image, K-means.

I. INTRODUCTION

Diabetic retinopathy (DR) is one of the leading causes of blindness in the world among patients suffering from diabetes. It is an ocular disease and progressive by nature. It is characterized by many pathologies, namely microaneurysms, hard exudates, soft exudates, hemorrhages, etc, among them presence of exudates is the prominent sign of non-proliferative DR. Both hard and soft exudates play a vital role in grading DR into different stages. In this paper, we present an efficient method to identify the hard exudates. The color image is read that uses srgb color space. The color transformation structure is created that defines a srgb to lab conversion. The candidate exudates are then detected using k-means clustering technique. The proposed method has yielded encouraging results. The original fundus image is represented by Fig.1 (a). Hard Exudates are primary sign of the DR. Exudates are an abnormality observed in the first phase of DR. Exudates are mostly in the form of clusters. These clusters may be adjacent to group of microaneurysms or near the anatomical area of fovea. Exudates are yellowish in color, and also they are deposits in the internal area of retina. The locations of these hard exudates are normally in the posterior pole of the fundus. The analysis and diagnosis of the disease by ophthalmologists from detection of exudates necessarily needs the chemicals for dilation of pupils. These chemicals may lead to side effect on patients and also involves great deal of time investment; this becomes hectic task for ophthalmologists and inconvenience for the patients. Hence various digital image processing techniques are used for detection of exudates. Figure below shows the Retinal image with hard exudates and showing typical components of retina such as optic disc, etc.

(a)

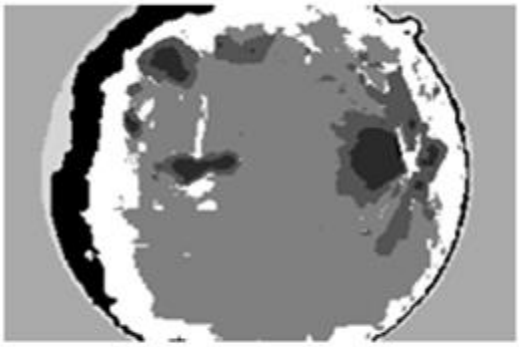
Fig. 1 (a) Original Image

II. Preprocessing

Image pre-processing is the initial step in automated retinal pathology diagnosis. It includes techniques such as contrast enhancement, gray/green component, image de-noising, etc. In a binary image, white pixels are normally taken to represent foreground regions, while black pixels denote background. In case of Gray scale image, the intensity value represents height above a base plane. Thus, the Gray scale image represents a surface in three-dimensional Euclidean space [7]. In the RGB images the green channel exhibits the best contrast between the vessels and background while the red and blue ones tends to be more noisy. The original fundus image is read from the database. The color image is read that uses srgb color space. The color transformation structure is created that defines a srgb to lab conversion.

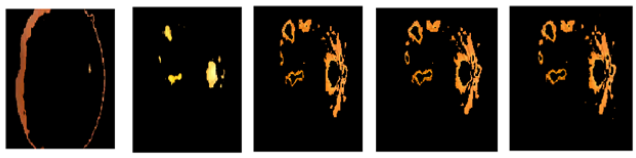
III. K-Means Clustering

Clustering is a way to separate groups of objects. K-means clustering treats each object as having a location in space. It finds partitions such that objects within each cluster are as close to each other as possible, and as far from objects in other clusters as possible. K-means clustering specifies the number of clusters to be partitioned and a distance metric to quantify how close two objects are to each other. Since the color information exists in the 'a*b*' space, your objects are pixels with 'a*' and 'b*' values. Use kmeans to cluster the objects into three clusters using the Euclidean distance metric. For every object in the input image, kmeans returns an index corresponding to a cluster. The cluster_center output from kmeans will be used later in the demo. Label every pixel in the image with its cluster_index which is represented by Fig.2 (a). The clustering is repeated three times to avoid the local minima. The objects are separated by color using pixel_labels, which will result in five images. The objects in different clusters are displayed in Fig.3. The hard exudates are detected in cluster 2 objects in Fig.3 (b).



(a)

Fig.2 (a) Image Labeled by Cluster Index



(a) (b) (c) (d) (e)

Fig3. (a) Objects in Cluster 1 (b) Objects in Cluster 2 (c) Objects in Cluster 3 (d) Objects in Cluster 4 (e) Objects in Cluster 5

IV. CONCLUSION

Diabetic retinopathy is one of the vascular complications in retina, which is related to diabetes. Diabetic eye problem is because of damage of small vessels in eye. It can result in severe loss of vision or even blindness. Cluster Based Method is useful for the identification of hard exudates in the retina using kmeans clustering. Major advantage of using this technique is that, it is fast and easy to identify the abnormalities. A set of features are extracted and relevant features used for the final feature classification. So, this technique is useful for identifying hard exudates in retina images.

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