

Automatic Detection & Classification of Diabetic Retinopathy using Exudates & Hemorrhages in Retinal Fundus Images

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Abstract— This paper describes an automatic detection of Diabetic retinopathy and classification of their stages in RGB fundus image. Diabetic retinopathy is a common disease in diabetes patients that affects vision badly and is world's leading cause of blindness. This can be prevented if diabetic retinopathy is detected in early stages by identifying exudates & hemorrhages in color fundus images of the back side (Retina) of human eye.

Keywords— Diabetes, Diabetic Retinopathy, Fundus Image, Hemorrhage, Image Processing, Exudates.

1 INTRODUCTION

Diabetic retinopathy is very common disease in diabetes patients in developed countries and is one of the major cause of blindness in diabetic patients. Recent health studies estimate that 54 million American have diabetes and most of them don't know it. World Health Organization reveal that 347 million people have this diabetes worldwide. As many as 25,000 people have lost their vision because of diabetic retinopathy every year. The number of diabetes patients is increasing day by day due to population growth, aging, urbanization, and physical inactivity. The total number of diabetes patients is predicted to increase from 171 million in 2000 to 366 million in 2030 [1]. Diabetic retinopathy is an effect of diabetes which occurs due to impairment of retinal blood vessels by enlarging and leaking fluid. Approximately 40% of diabetic patients suffer from diabetic retinopathy, out of which an estimated 5% face the sight-threatening form of this disease [2]. Diabetic retinopathy is the leading cause of new blindness in persons aged 25-74 years in the United States.

There are two types of stages in Diabetic Retinopathy

- (1) Proliferative Diabetic Retinopathy. In proliferative diabetic retinopathy rapid growth of abnormal blood cells start
- (2) Non-Proliferative Diabetic Retinopathy. In non-proliferative diabetic retinopathy there is no growth of abnormal blood cells.

There are further four stages of diabetic retinopathy. (in fig. 1)

- (1) **Mild Non-Proliferative DR:** This is early stage of disease. In this early stage disease Microaneurysms i.e small swellings in the tiny blood vessels of the retina will be formed.
- (2) **Moderate Non-Proliferative DR:** In this 2nd stage of DR swellings progress and some vessels which are responsible to nourish retina become blocked.
- (3) **Severe Non-Proliferative:** Many more blood vessels become blocked in this stage, so damaged retina

then signals body to produce new vessels.

- (4) **Proliferative DR:** In this stage signals sent by retina will cause growth of abnormal blood vessels and this can even cause hemorrhages leading to complete blindness.

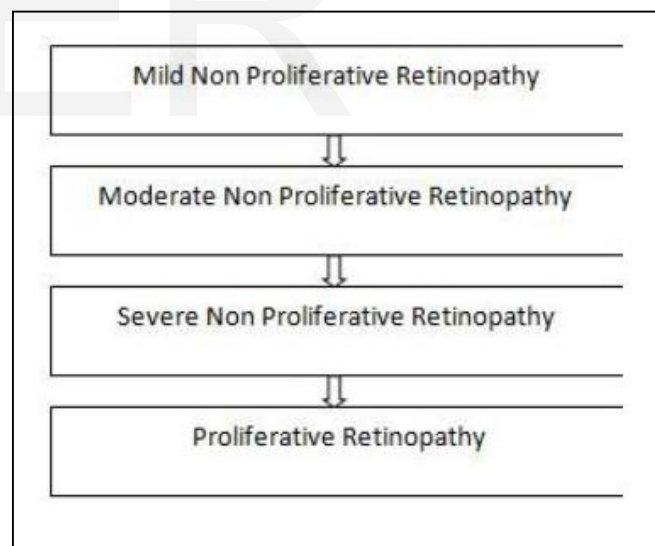


Fig 1. Four Stages of Diabetic Retinopathy

Generally clinical detection and diagnosis of this disease is made by the medical specialists who on the basis of his/her experience tells about the stage of this disease but as image processing excelled in the field of medical diagnosis it is very handy to use image processing to help diagnose & classify this disease.

Different stages of diabetic retinopathy defined by retinal fundus images are shown in the figure 2.

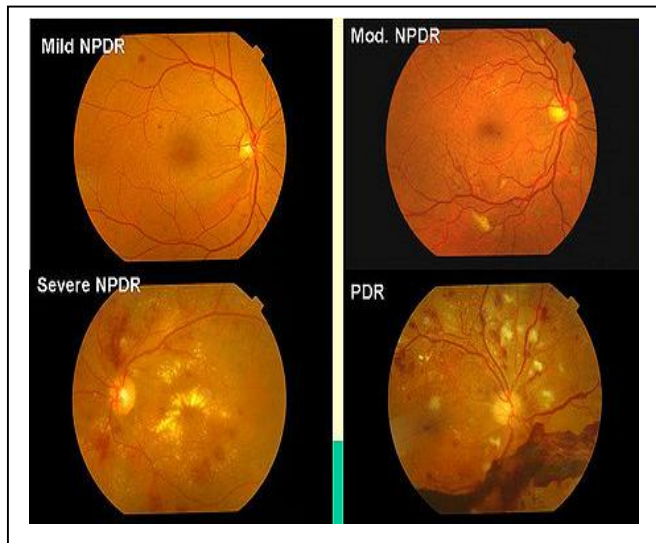


Figure 2 Stages of DR in Fundus Image

The diabetes impaired blood vessels in the retina tends to leak fluid and blood into the eye and also deposits cholesterol or other fats from the blood. In early stage, no changes may occur, but gradual increase in vision loss leads to blindness as shown in figure 3.

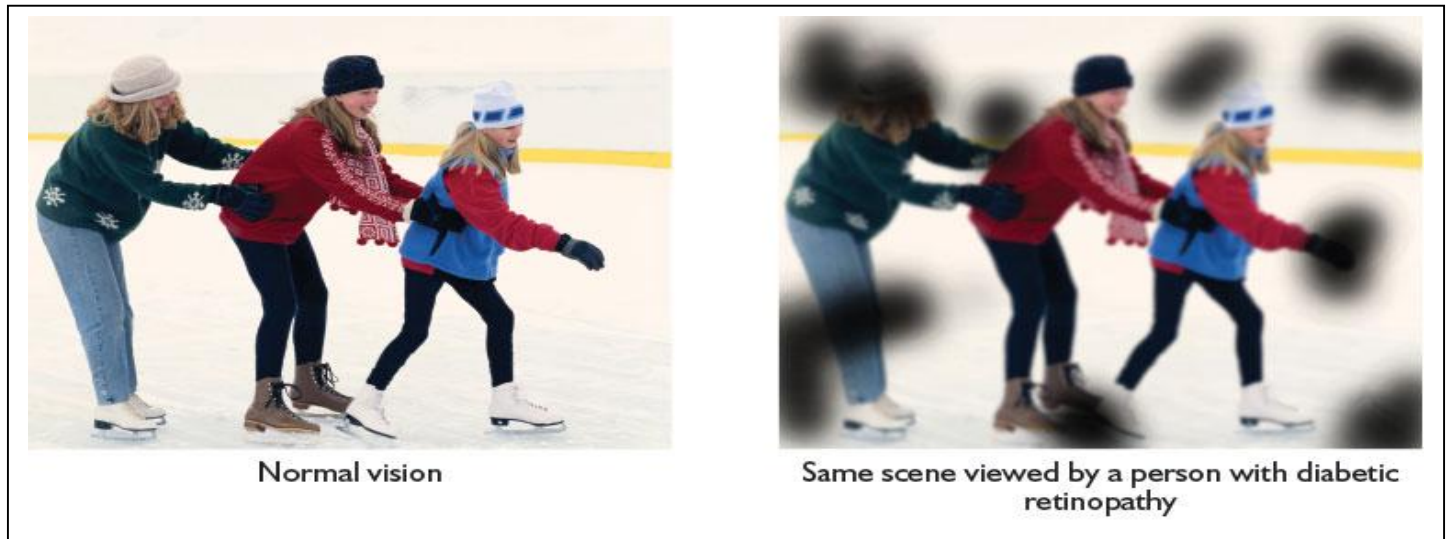


Figure 3. Normal vs Diabetic Ratenopathy patient's vision

2 METHODOLOGY

In this methodology, an approach is purposed for automatic detection and classification of diabetic retinopathy using High Resolutiion Retinal Fundus images. In this process different

features of diabetic ratenopathy are detetcted and classified to help detect and classify the stage of the disease. In first step High Resolution Fundus images will be used as i nput in the system. Then preprocessing will be applied for improving the image and removing noise from the images it is the must do step in image proc essing as the fundus images taken by the camera often have noise and non uniform brightness which usually make it very complicated to detect required features with similar intensity from the background [3]. Normally fundus images are colored images and green channel clearly exhibits the red color feat ures of all features [i.e. Hemorrhages, MA, cotton, exudates, vessels etc.] in fundus image. So in proposed method green channel is used. In next step image will be converted into gray scale. Then in next step thresholding will be applied. The candidate vessels, hemorrhages & exudates are then binarized by multilevel thresholding of the gray-scale image. Here a correct t hresholding value is very important as smaller value will cause more noise and larger value can cause in loss of some blood vessels from the gray-scale image. Now the output image is ready for feature detetction.

Detetcion of Hard Exudates:

Exudates were defined as yellow lesions of various shapes & sizes with relatively distinct margins. The basis of RRGs is the identification of similar pixels within a region to determeine the location of the boundary. To establish if two adjacent pixels are similar they must satisfy some criterion such as gray level or color. In RRGs, adjacent pixels within the same region are considered to have fairly homogeneous gray scale properties.

Detection of Hemorrhages:

Morphological top hat transform is an operation which is used to extract small objects from an image. Generally, it can be divided into two techniques; white top hat and black top hat. White top hat is the difference between the image and the opening of the image while black top hat can be described as the difference between the image and the closing of the im-

age. In the en classification defined by Internation council of ophthamologists is used to classifiy the stage of diabetic rate-nopathy.

Methodology adopted in this research is represented in figure 4.

Flow Diagram

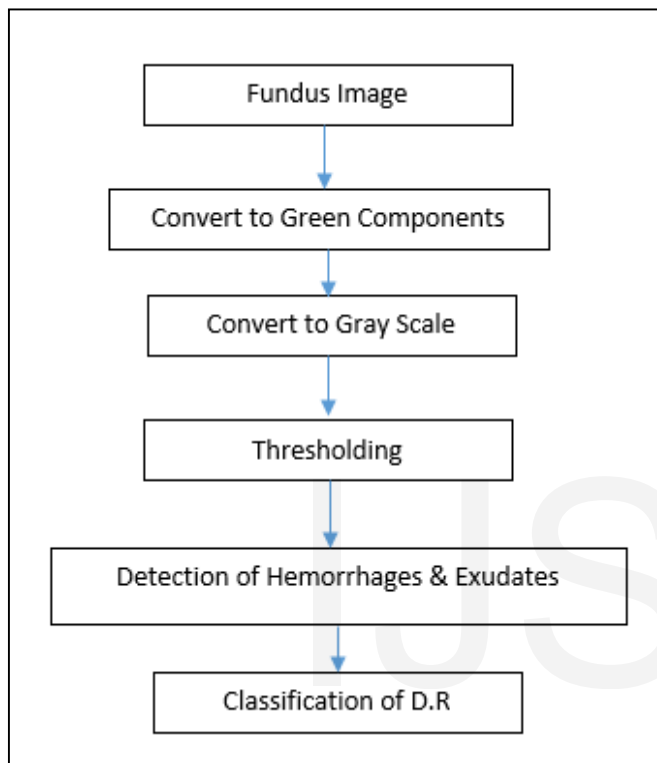


Figure 4. Methodology

3 CONCLUSION

Proposed methodology's vital concentration is o n Automatic Detetcion & Classification of Diabetic Ratenopathy using Exudates & Hemorrhages in Retinal Fundus Images. This automated system is built to help ophthologists to identify diabetic retinopathy and save patients to vision lose by detecting DR signs in early stages. Thus reducing the work of ophthamologists in detection of diabetic reti-nopathy and its stages,

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