

# Exudate Extraction From Fundus Images Using Machine Learning

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## ABSTRACT

Patients suffering from diabetes have to bear several other disorders due to this. Diabetic retinopathy is one such disorder which affects diabetic patients. This disorder affects the patient's eye leading to permanent blindness if left untreated. Another disorder is exudates in which lipid residues leak out from damaged capillaries. It appears as yellow flecks. Hard exudates can lead to life threatening disorders. Detecting hard exudates helps the ophthalmologist to diagnose the severity of the patient's condition and in turn help in better medication. This paper presents a method to adjust the contrast of the image which in turn helps in detecting the hard exudates which can be used for further processing. In this work, Otsu algorithm is applied and then compared with machine learning techniques due to the disadvantage of Otsu.

## KEYWORDS

Exudates, Linear Brightness Transform, Machine Learning, Optic Disk

## 1 INTRODUCTION

Pancreas produce insulin needed for our body. When it fails to produce this for prolonged periods, it results in disorders like high blood sugar levels which in turn gives rise to Diabetes mellitus (DM) or Diabetes as is commonly called. Frequent urination, increased thirst and increased hunger are certain factors through which we can identify that a person is suffering from diabetes. Treating this disease is very much needed as it may lead to acute complications like diabetic keto acidosis, hyperosmolar hyperglycaemic state, or death if left untreated. Treatment for diabetic mellitus patients include drugs which lowers the glucose level in the blood. Few of the life threatening complications are damage to the eyes, foot ulcers, heart related disease, chronic kidney failures, foot ulcers and many more. Selection of the drug depends on many factors like the age of the person, and nature of diabetes. Excluding insulin, liraglutide, pramlintide and exenatide all other medication is orally given. Hence the name oral hypoglycaemic agents. Mohammed Shafeeq Ahmed et.al. (2017)(Ahmed & Indira, 2017) have proposed that colour-based pathology can be used to classify Diabetic Retinopathy. The fundus camera generates fundus images in RGB colour. Three Sigma is a statistical measure which is used to compute the colour intensity range of exudates in pixels. The images of the retina thus obtained are first subjected to preprocessing where the color intensity is enhanced and elimination of optic disk takes place. The results so obtained facilitates the ophthalmologist in diagnosing the disease.

Ahmed Hashim Al-Sharfaa et. al. (2021)(Al-Sharfaa et al., 2021) have come up with a new algorithm to localize and segment optical disk prior to process of secretion in contrast of other features of the retinal image. Mohamed B et. al. (2017) used two images Gcor and Gs to extract fundus using using thresholding and morphology parameters. Z. A. Omar et. al. (2017)(Carrera et al., 2017) have proposed the Green Component extraction. First step noise is eliminated using Media filtering.

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In the next stage contrast is adjusted and top hat transformations using Contrast Limited Adaptive Histogram Equalization (CLAHE) is performed to get exudates.

Enrique V. Carrera et. al. (2019)(Santhakumar et al., 2016) have proposed a model which classifies the non-proliferative diabetic retinopathy given any retinal data using Digital Image Processing. Support Vector Machines are used to identify the grade of retinopathy in a retinal image. This is done by initially isolating blood vessels, and later hard exudates. Santhakumar R et. al. (2016)(Qomariah & Tjandrasa, 2017) have proposed a tool to identify exudates using SVM Classifier. Here the diseased region is localised and broken into a rectangular patch and the classifier is trained to identify the disease(Rajput & Patil, 2014)(Rawat & Singh, 2016)(Eadgahi & Pourreza, 2012).A similar approach has been displayed in (Rajput & Patil, 2014)(Rawat & Singh, 2016).

## 1.1 Medical Disorders Caused by Diabetes

Diabetes mainly affects the heart. About 75% of the people suffer from coronary artery disease or peripheral artery disease. The primary complications due to damage in small blood vessels include damage to the eyes, kidneys, and nerves. Damage to the eyes is also called as diabetic retinopathy(Eadgahi & Pourreza, 2012). This can lead to vision loss and blindness.

Some of the disorders caused are

### 1.1.1 Diabetic Retinopathy

Diabetic retinopathy affects blood vessels in the light-sensitive tissue called the retina that lines the back of the eye

### 1.1.2 Diabetic Macular Edema (DME)

A consequence of diabetic retinopathy, DME is swelling in an area of the retina called the macula.

### 1.1.3 Exudates

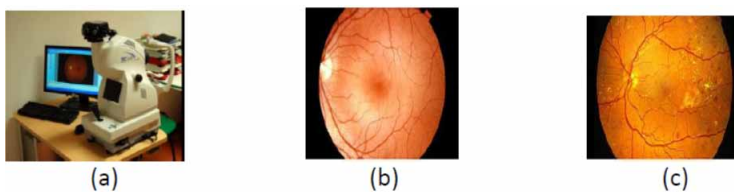
An exudate is any fluid that filters from the circulatory system into lesions or areas of inflammation (Santhakumar et al., 2016). The fluid is composed of serum, fibrin, and white blood cells. There are two types of exudates (Santhakumar et al., 2016) Soft Exudates and Hard Exudates

## 1.2 Fundus Imaging

Inorder to obtain a fundus image, a person should sit with their chin on the chin rest position. The camera is then focussed by an ophthalmic photographer. The photo gets a picture of the retina, where the optical images are translated into electrical impulses.

The photograph contains coloured filters and a number of dyes like indocyanine green and fluorescein. A fundus camera has a microscope attached to it.

Figure 1. Starting from a Fundus Camera b Normal fundus image c Fundus image with exudates



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