

Chapter 6

Bloodless Technique to Detect Diabetes using Soft Computational Tool

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ABSTRACT

Detection of diabetes using bloodless technique is an important research issue in the area of machine learning and artificial intelligence (AI). Here we present the working of a system designed to detect the abnormality of the eye with pain and blood free method. The typical features for diabetic retinopathy (DR) are used along with certain soft computing techniques to design such a system. The essential components of DR are blood vessels, red lesions visible as microaneurysms, hemorrhages and whitish lesions i.e., lipid exudates and cotton wool spots. The chapter reports the use of a unique feature set derived from the retinal image of the eye. The feature set is applied to a Support Vector Machine (SVM) which provides the decision regarding the state of infection of the eye. The classification ability of the proposed system for blood vessel and exudate is 91.67% and for optic disc and microaneurysm is 83.33%.

INTRODUCTION

Diabetic retinopathy is the commonest cause of blindness and one of the commonest cause of vision defects in both developing and developed countries (Chaudhuri, Chatterjee, Katz, Nelson & Goldman, 1989). The World Health Organization (WHO) has estimated that, the number of adults with diabetes increasing alarmingly: from 135 million in 1995 to 300 million in 2025 (Premi, 2015). In India, this increases is expected to be greatest; 195 from 18 million in 1995 to 54 million in 2025. Studies done by the ICMR in the early 1970s had shown the prevalence of diabetes in India to be 2.5 and 1.5% in the rural

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population. However recent reports have shown the prevalence to be in the range of 12% to 14% in the urban population. Of these patients with diabetes, over 20% are expected to be suffering from diabetic retinopathy. The prevalence of diabetes in the rural population is expected to be about 5%.

Diabetes is a disorder of metabolism. The energy required by the body is obtained from glucose which is produced as a result of food digestion (Chaudhuri, Chatterjee, Katz, Nelson & Goldman, 1989). Digested food enters the body stream with the aid of a hormone called insulin that is produced by the pancreas, an organ that lies near the stomach. During eating, the pancreas automatically produces the correct amount of insulin needed for allowing glucose absorption from the blood into the cells. In individuals with diabetes, the pancreas either produces too little or no insulin or the cells do not react properly to the insulin or the cells don't react properly to the insulin that is produced (Bevilacqua, Cambo, Cariello & Mastronardi, 2005). The buildup of glucose in the blood, overflows into the urine and then passes out of the body. Therefore, the body loses its main source of fuel even though the blood contains large amount of glucose. Basically there are three types of diabetes:

- 1) Diabetes caused as a result of auto immune problem. The immune system of the body destroys the insulin producing beta cells in the pancreas leading to no or less production of required insulin by the pancreas.
- 2) Diabetes due to malfunctioning of beta cell itself. This malfunction includes non production of insulin or situation known as insulin resistance (Wang, Hsu, Goh & Lee, 2000).
- 3) Third type is known as gestational diabetes. During this stage, the body resist the effect of insulin produced.

The effect of diabetes on the eye is called Diabetic Retinopathy (DR). It is known to damage the small blood vessel of the retina and this might lead to loss of vision. The disease is classified into three stages viz. Background Diabetic Retinopathy (BDR), Proliferate Diabetic Retinopathy (PDR) and Severe Diabetic Retinopathy (SDR). In BDR phase, the arteries in the retina become weakened and leak, forming small, dot like haemorrhages. These leaking vessels often lead to swelling or edema in the retina and decreased vision. In the PDR phase, circulation problems cause areas of the retina to become oxygen deprived or ischemic. New fragile, vessels develop as the circulatory system attempts to maintain adequate oxygen levels within the retina. This phenomenon is called neovascularisation. Blood may leak into the retina and vitreous, causing spots or floaters, along with decreased vision. In the SDR phase of the disease, there is continued abnormal vessel growth and scar tissue, which may cause serious problems such as retinal detachment and glaucoma and gradual loss of vision.

Diabetes is a major disease affecting a sizable portion of the humanity. Hence, detection of diabetes and its subsequent is a major challenge faced by the medical fraternity. Traditional methods of detection of diabetes involves pain and necessity of blood which has certain constraints including the possibility of contamination and related health hazards. Hence, there is a necessity to develop systems which are painless and also don't require blood samples. Detection of diabetes using bloodless technique is an issue which is in the limelight of research in the field of machine learning and artificial intelligence (AI). It primarily intends to contribute towards faster and efficient means of detection and subsequent diagnosis of diabetes. Here, we present the working of a system designed to detect the abnormality of the eye with pain- and blood-free method. The typical features for diabetic retinopathy (DR) are used along with certain soft computing techniques to design such a system. The essential components of DR are blood vessels, red lesions visible as microaneurysms, hemorrhages and whitish lesions i.e., lipid exudates and

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