A NOVEL METHOD TO DETECT THE FOVEA OF FUNDUS RETINAL IMAGE

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ABSTRACT

Image processing technique is utilized in medical field widely nowadays. Hence therefore this technique is used to extract the different features like blood vessels, optic disk, macula, fovea etc automatically of the retinal image of eye. This project presents a simple and fast algorithm using Mathematical Morphology to find the fovea of fundus retinal image. The image for analysis is obtained from the DRIVE database. Also this project is enhanced to detect the Diabetic Retinopathy disease occurring in the eye.

Keywords: Fovea, Macula, Optic Disk, Blood Vessels, Mathematical Morphology.

I. INTRODUCTION

Fovea- the central part of an eye is the most important part of retina. It is responsible for human vision. It consists of many delicate cones which if destroyed would lead to blindness. The conventional manual detection of fovea region by ophthalmologists is time consuming. In countries like India automation field is highly developing. So this method of fovea detection is greatly helpful for the ophthalmologists.

The macula is the most darkest part in the form of circle. The fovea is 200μ in radius. It is located at a distance of 2.5 times the diameter of optic disk (OD).

The various methods to detect the fovea region includes:

Chutataper3 proposed a method based on parabola fitting on the main blood vessels. There are several algorithms in the literature for blood vessels detection. These results can be compared through a standard DRIVE database images[4]. J. Staal et al. [5] have worked with a method based on extraction on image ridges, which coincide approximately with vessel centerlines. The accuracy of this method is 94.42% in finding the blood vessels with DRIVE database. blood vessels with DRIVE database.

S. Sekhar et al. [6] have localized the macula region by employing angular information at center of the OD. The macula region is found by thresholding on the macula candidate region. Here one limitation is that, the macula region should be nearer to the center of the retina image disk. But it can happen that the macula region is far away from the expected location. Then this method will not work properly.

II. PROPOSED SYSTEM ARCHITECTURE

The retinal fundus image consists of a network of blood vessels. These vessels originate from the optic disk. Based on the database from which the image is obtained, decides the location of optic disk. Initially the blood vessels of the disk is found using matlab morphological filters. Based on the adaptive mathematical morphology, the origin of optic disk is identified. The fovea is located at a distance of 2.5 times the diameter of optic disk from its centre. Fovea is identified using the sliding window technique.
2.1 BLOOD VESSEL EXTRACTION

**Step1:** To reduce correlated color information, RGB image is converted into gray-scale (I1). 
\[ I_1 = 0.3 \times R + 0.59 \times G + 0.11 \times B \]  

**Step2:** Morphological opening operation (I2) and Morphological closing operation (I3) is applied a disk shaped structuring element on gray-scale image to reduce the small noise and to remove the vessels structure.

**Step3:** It is followed by Top-Hat transformation (I4), to extract the vessels like structure. 
\[ I_4 = I_3 - I_1 \]

**Step4:** Above image is binarized to produce a resultant image by thresholding.

**Step5:** By connected component analysis, the noise is reduced for any arbitrary shape.

2.2 FOVEA EXTRACTION

**Step1:** Locate a point P horizontally at a distance 2.5 \( d \) from optic disk center towards the centroid.

**Step2:** Apply a \( k \times k \) sliding window along the strip and form the chain of numbers denoting the black pixels in the window.

**Step3:** Maximum run length of zeros is found in the number chain.

**Step4:** That is known as a fovea region. It is marked by a red coloured circle.

2.3 DIABETIC RETINOPATHY

In this project, fovea is detected in the retinal image which is used by physicians to identify any eye diseases. Apart from this an enhancement is added to it. That includes identifying a disease called diabetic retinopathy. Diabetic retinopathy is primarily a lesion of the retinal capillaries. Later this extends to the larger vessels known as veins, arterioles and arteries.

2.3.1 DIABETIC RETINOPATHY DETECTION ALGORITHM

This disease is isolated using the following algorithm.

**Step1:** Extracting the region of interest in the retina through feature extraction method.

**Step2:** Extracted region is further processed by implementing principal component analysis.

**Step3:** Checking of that image to spot the disease by visualizing the change in the shape of fovea.

III. SIMULATION

![Input Image](image1)

![Vessel Detected Image](image2)
IV. CONCLUSION

This project analyses the method to detect the fovea region of the eye. Two major algorithms are considered in analyzing it. First algorithm involves the isolation of blood vessels and next algorithm deals with the localisation of fovea. This method is simple and efficient in extracting the fovea. In the proposed approach of blood vessel detection, morphological operations and geometrical functions are used to arrive the output. In the second algorithm of fovea localisation, sliding window technique is utilized to find the gray mixed black colour fovea. The proposed approach is further enhanced to detect the diabetic retinopathy disease through feature extraction and principal component analysis method. It performs well on individuals own data set consisting of images with variation. This method is robust also. This proposed methodology can be utilized in hospitals to detect diseases occurring on the eyes by doctors easily. Future scope of this project is to detect many eye diseases thus making mankind to be benefitted in large extent to be free from eye diseases leading to blindness with higher efficiency.
REFERENCES

overview.


http://www.isi.uu.nl/Research/Databases/DRIVE/.
