ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING

National Conference on Advanced Innovation in Engineering and Technology (NCAIET-2015)

Alva's Institute of Engineering and Technology, Moodbidri

Vol. 3, Special Issue 1, April 2015

Diabetic Retinopathy using Computer Vision

Netra Yaradoni[1], Manjunath R Raikar [2]

M.Tech (CSE), AIET, Moodbidri, India[1]

M.Tech, Assistant Professor, Department of CSE, AIET, Moodbidri, India[2]

Abstract: Hyperglycemia and diabetes result in vascular complications, most particularly diabetic retinopathy (DR). The prevalence of DR is increasing and is a most important cause of blindness and visual impairment in developed countries. Current methods of detecting, screening, and monitoring DR are based on subjective human evaluation, which is also slow and time-consuming. As a result, initiation and progress monitoring of DR is clinically hard. Computer vision methods are developed to separate and detect two of the most common DR functions—dot hemorrhages (DH) and exudates. Diabetic retinopathy, an eye disorder caused by diabetes, is the main cause of blindness. This may result in an unprecedented number of persons becoming blind unless diabetic retinopathy can be detected early. Hence here we are trying to detect all potential exudate regions in a fundus image of format .png. And the algorithm counts the number of pixels present in the area of potential Exudates. And also we are trying to detect the position of all size Dot hemorrhages and count the same. And the algorithm places circle around all the detected smaller and larger size Dot hemorrhages to visualize the presence of smaller and larger size Dot hemorrhages.

Keywords: Fundus Images, Hemorrhages, Exudate Image Processing, Diabetic Retinopathy.

I. INTRODUCTION

Diabetic retinopathy (DR) is one of the main causes of blindness and visual impairment in developed countries In the United States the prevalence rates of retinopathy and vision-threatening retinopathy are estimated to be 40.3 and 8.2%, respectively, for diabetic adults 40 years or older Within the next 15 to 30 years the number of people with diabetes is expected to double due to factors such as obesity, an aging population, and inactive lifestyles. Studies have shown that early detection, combined with appropriate treatment and management can prevent the loss of vision in up to 95% of cases.

DR is the manifestation of systemic disease, which affects up to 80% of all patients who have had diabetes for 10 years or more. The high prevalence of diabetes therefore makes mass screening an expensive and time-consuming process. Diabetic retinopathy results from the leakage of small vessels in the retina correlated to a prolonged period of hyperglycemia. In the early stages of the disease, known as non proliferative retinopathy, there may be hemorrhages due to bleeding of the capillaries or exudates resulting from protein deposits in the retina. There is usually no vision loss unless there is a build-up of fluid in the center of the eye. As the disease progresses, new abnormal vessels grow in the retina, known as neovascularization. These vessels frequently leak into the vitreous. This stage of the disease is called proliferative retinopathy and may cause severe visual problems.

The goal of the screening system is to detect the non proliferative stage of DR so that the disease can be managed appropriately to decrease the chances of vision impairment. Two independent algorithms were developed to detect exudates and dot hemorrhages (DHs). Information from color, morphology, and intensity gradients of the fundus photograph provides the means to detect the number of exudates and DHs, thus determining the presence of DR. It uses additional standard computer vision algorithms to identify and eliminate false positives, without reducing true positive results. Overall, this article thus focuses on the problem of detecting DR accurately, rather than just grading images, which is a salient difference from most prior work. In addition it focuses on identifying lesions or diseases independently, rather than all at once, even though only one image is used. Finally, it is thus based on directly identifying physiologically observed states and uses that information directly, which some other approaches ignore in whole or part.

In the type 1 diabetes, the insulin production in the pancreas is permanently damaged, whereas in the type 2 diabetes, the person is suffering from increased resistance to insulin. The type 2 diabetes is a familial disease, but also related to limited physical activity and lifestyle. The diabetes can cause abnormalities in the retina kidneys (diabetic nefropathy), and nervous system (diabetic neuropathy). The diabetes is also a major risk factor in cardiovascular diseases. The diabetic retinopathy is a microvascular complication of diabetes, causing abnormalities in the retina, and in the worst case, blindness. Typically there are no salient symptoms in the early stages of diabetic retinopathy, but their number and severity predominantly increase with time. The diabetic retinopathy typically begins as small changes in the retinal capillaries. The first detectable abnormalities are mircroaneurysms which are local distensions of the retinal capillary and when ruptured, cause intraregional hemorrhage. The disease severity is classified as mild

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING

National Conference on Advanced Innovation in Engineering and Technology (NCAIET-2015)

Alva's Institute of Engineering and Technology, Moodbidri

Vol. 3, Special Issue 1, April 2015

non-proliferative diabetic retinopathy when the first apparent microaneurysms appear in the retina.

II. LITERATURE SURVEY

To determine the prevalence of diabetic retinopathy among adults 40 years and older in the United States[1]. Pooled analysis of data from 8 population based eye surveys was used to estimate the prevalence, among persons with diabetes mellitus (DM), of retinopathy and of vision-threatening retinopathy—defined as proliferative or severe non proliferative retinopathy and/or macular edema. Within strata of age, race/ethnicity, and gender, US prevalence rates were estimated by multiplying these values by the prevalence of DM reported in the 1999 National Health Interview Survey and the 2000 US Census population.

To calculate the performance of a system for automated detection of diabetic retinopathy in digital retinal photographs, built from published algorithms, in a large, representative, screening population [2]. Eye Check diabetic retinopathy screening project imaged with three types of cameras at 10 centers. Inclusion criteria incorporated no earlier Diagnosis of diabetic retinopathy, no previous visit to ophthalmologist for dilated eye exam, and both eyes photographed.

Considering the segmentation results of region growing depend on two key factors: seed selection and growing strategy, this paper proposed a method of adaptive seeded region growing based on edge detection, texture extraction and cloud model [3]. Firstly, proposed a new method to extract region seeds automatically based on spectrum features, edge information and texture features. According to two conditions defined by us, region seeds could be extracted as accurately as possible. Secondly, planned an adaptive region growing strategy based on cloud model. This policy consisted of three major stages: expressing region by cloud model, calculating the qualitative region concept based on the backward cloud generator, and region growing based on cloud synthesis.

Early diagnosis and timely treatment of these clinical signs such as hard exudates could efficiently prevent blindness [4]. The occurrence of exudates inside the macular region is a main hallmark of diabetic macular edema and allows its detection with high sensitivity. Here combine the k-means clustering algorithm and mathematical morphology to detect hard exudates in retinal images of several diabetic patients.

III. PROPOSED SYSTEM

A computer system will be developed using image processing techniques to detect early lesions of diabetic retinopathy.
Two algorithms –

- Exudate Detection
- Dot haemorrhages

IV. PROBLEM STATEMENT

A. Objectives

Exudates detection: Exudates are bright lipids leaked from a blood vessel.

The leaked fluid tends to stay close to the lesion, giving a generally well-defined edge suitable for computer analysis.

Dot Hemorrhage detection-Smaller and bigger regions: Hemorrhages are a secondary sign of DR resulting from ruptured micro aneurysms, capillaries and venues.

The classification of hemorrhages depends on their location within the retinal layers.

B. Methodology

Exudates detection

- Pre-processing of an Image
- Removing rectangular border
- Finding circular border of an Image
- To detect the Blood vessels in an Image
- Final Identification

Dot hemorrhages

- Identify the smaller size Dot Hemorrhage region
- Count the smaller size Dot Hemorrhages
- Detect larger size Dot Hemorrhages
- Identify the larger size Dot Hemorrhage regions
- Count the larger size Dot Hemorrhages
- Calculate the accuracy of system

V. SYSTEM DESIGN

A. Design for Exudate Detection region

Exudates are common abnormalities in the retina of diabetic patients and these are bright lipids leaked from blood vessels.

In detection phase first we preprocess .png format. After preprocess remove rectangular border in an image.

Next step unwanted regions like border of the image is identified and grouped into logical array. After grouped into logical array next step is detection of blood vessels.

The blood vessels which are not the region of interest hence needs to be eliminating to accurately detect the potential Exudates in an image.

Both the optic disk and exudates have same intensities range hence we need to eliminate the optic disk from the processed image to find the potential Exudates.

After removing optical disk then the image is with exudates region.

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING

National Conference on Advanced Innovation in Engineering and Technology (NCAIET-2015)

Alva's Institute of Engineering and Technology, Moodbidri

Vol. 3, Special Issue 1, April 2015

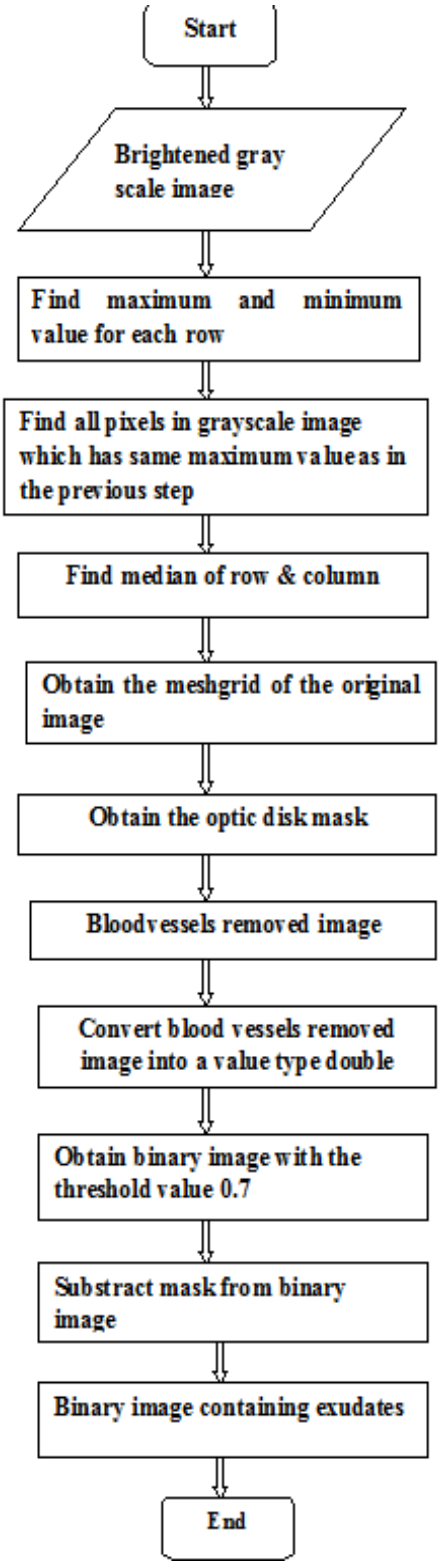

Fig 1: Flow diagram for exudates detection algorithm

B. Design for DotHemorrhage Detection region

Hemorrhages are a secondary sign of DR resulting from ruptured microaneurysms, capillaries, and venules. The classification of hemorrhages depends on their locations within the retinal layers.

1. Detection of Small Size Dot Hemorrhages

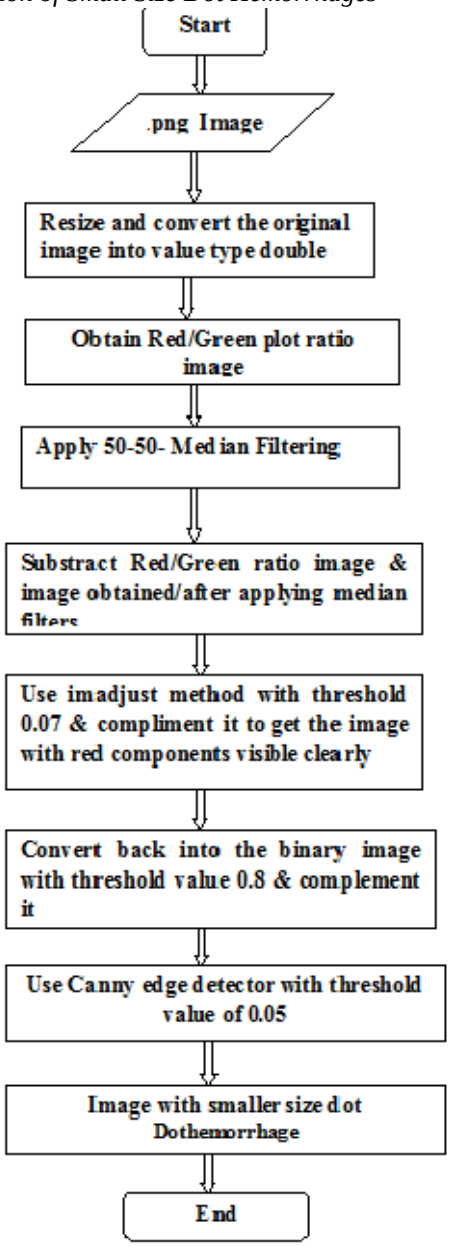

Fig 2 : Flow diagram for smaller size Dot Hemorrhage detection algorithm

Before applying any method to detect Dot hemorrhage first to preprocess the image. In preprocessing stage red and green color compents are plotted. Median filter is used to reduce the noise. Median filter is a nonlinear operation often used in image processing to reduce salt & pepper noise. Imcompliment function computes the compliment of the image. Next step is to identify smaller size DotHemorrhage. In small size DotHemorrhage canny edge detector has low threshold. So by using 0.05 thresholds we can identify small size DotHemorrhages. Canny method select the user-defined threshold check box to detect the low & high threshold values.Afrter identifying smaller

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING

National Conference on Advanced Innovation in Engineering and Technology (NCAIET-2015)

Alva's Institute of Engineering and Technology, Moodbidri

Vol. 3, Special Issue 1, April 2015

size DotHemorrhages to fill the regions using imfill functions. And strel function create morphological structuring elements. And strel functions creates the disk shaped structuring elements by finding the radius of an image. Finally counts the number of smaller size Dot Hemorrhages.

2. Detection of Larger Size Dot Hemorrhages

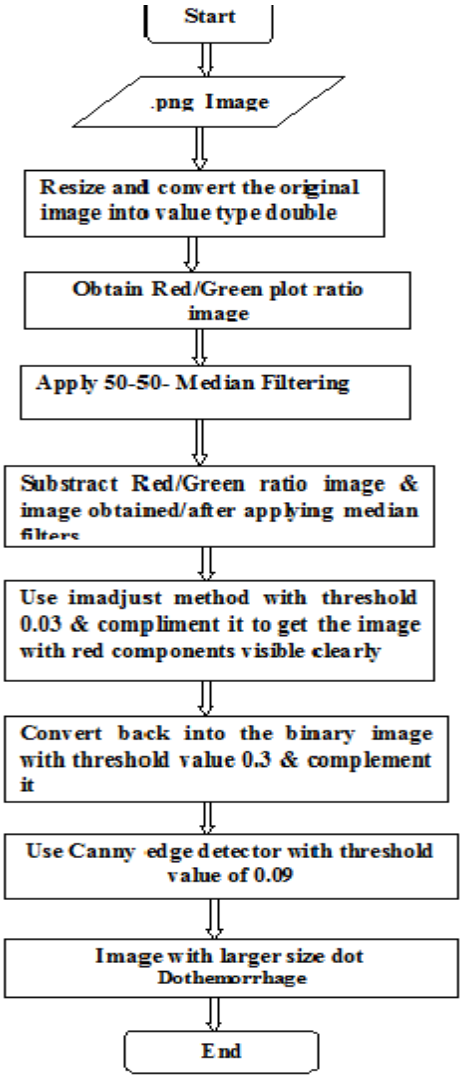

Fig 3: Flow diagram for larger size Dot Hemorrhage detection algorithm

Before applying any method to detect Dot hemorrhage first to preprocess the image. In preprocessing stage red and green color compents are plotted. Median filter is used to reduce the noise. Median filter is a nonlinear operation often used in image processing to reduce salt & pepper noise. Imcompliment function computes the compliment of the image. Next step is to identify larger size DotHemorrhage. In larger size DotHemorrhage canny edge detector has low threshold. So by using 0.09 thresholds we can identify larger size DotHemorrhages. Canny method select the user-defined threshold check box to detect the low & high threshold values.Afrter identifying larger size DotHemorrhages to fill the regions using imfill functions. And strel function create morphological structuring elements. And strel functions creates the disk shaped structuring elements by finding the radius of an image. Finally counts the number of larger size DotHemorrhages.

VI. APPLICATION AND CHALLANGES

"Vision 2020 – Right to Sight" is a global initiative for the elimination of avoidable blindness. It is a joint program of World Health Organization (WHO) and International Agency for the Prevention of Blindness (IAPB). According to global facts 285 million people are visually impaired worldwide. Vision 2020 welcomes research institutions to give a helping hand in reaching the goal. It seeks to develop and disseminate the best possible information and guidance to train professionals like doctors, nurses and paramedical staffs. This could be achieved by developing tools that can automatically detect characteristic features of the disease so that the tools can assist medical professionals who are not trained in ophthalmology in diagnosing the patients in early stages. There by taking further actions to treat the patient with early stage of disease or refer to ophthalmologists in severe cases.

Live images will be taken from diabetic patients. The functionality specified here is Exudate detection and Dot hemorrhage detection. The GUI should provide the user with an option to browse through the system current folder and load the required images as inputs. System should find out the accuracy of system. System should be capable of performing following functions.

- Identify the Exudate regions.
- Identify the smaller and larger size Dot hemorrhage regions

VII. CONCLUSIONS

Dot hemorrhage detection algorithm has two types one for detecting smaller size Dot hemorrhage detection and another is for identifying larger size Dot hemorrhages. Smaller size Dot hemorrhages detection algorithm involves three stages- Preprocessing of an fundusimage, identifying all potential smaller size Dot hemorrhages, counting smaller size Dot hemorrhage and plotting circle around the identified smaller size Dot hemorrhages.Larger size Dot hemorrhages detection algorithm involves three stages- Preprocessing of an image, dentifying all potential larger size Dot hemorrhages, counting larger size Dot hemorrhages and plotting circle around the identified larger size Dot hemorrhages.

REFERENCES

[1]. Kempen JH, O'Colmain BJ, Leske MC, Haffner SM, Klein R, Moss SE, Taylor HR, Hamman RF; Eye Diseases Prevalence Research Group. The prevalence of diabetic retinopathy

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING

National Conference on Advanced Innovation in Engineering and Technology (NCAIET-2015)

Alva's Institute of Engineering and Technology, Moodbidri

Vol. 3, Special Issue 1, April 2015

among adults in the United States. Arch Ophthalmol. 2004;122(4):552-63.

[2]. Abramoff MD, Niemeijer M, Suttorp-Schulten MS, Viergever MA, Russell SR, Van Ginneken B. Evaluation of a system for automatic detection of diabetic retinopathy from color fundus photographs in a large population of patients with diabetes. Diabetes Care. 2008;31(2):193-8.

[3]. Gang Li., and Youchuan Wan, "Adaptive seeded region growing for image segmentation based on edge detection", texture extraction and cloud model. ICICA'10 Proceedings of the First international conference on Information computing and applications, Springer-Verlag Berlin, Heidelberg, pp. 285-292, 2010I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.

[4]. Feroui Amel "Improvement of the Hard Exudates Detection Method Used For Computer- Aided Diagnosis of Diabetic Retinopathy "I.J. Image, Graphics and Signal Processing, 2012, 4, 19-27

[5]. ETDRS report number 9. Early Treatment Diabetic Retinopathy Study Research Group. Early photocoagulation for diabetic retinopathy. Ophthalmology. 1991;98(5 Suppl):766-85.

[6]. Kertes PJ, Johnson TM, editors. Evidence based eye care. Lippincott Williams & Wilkins; 2007.

[7]. Sánchez CI, Hornero R, López MI, Aboy M, Poza J, Abásolo D. A novel automatic image processing algorithm for detection of hard exudates based on retinal image analysis. Med Eng Phys. 2008;30(3):350-7.

[8]. Walter T, Massin P, Erginay A, Ordonez R, Jeulin C, Klein J. Automatic detection of microaneurysms in color fundus images. Med Image Anal. 2007;11(6):555-66.

[9]. Sinthnayothin C, Boyce J, Williamson T, Cook H, Mensah E, Lal S, Usher D. Automated detection of diabetic retinopathy on digital fundus images. Diabet Med. 2002;19(2):105-12.

[10]. Frame AJ, Undill PE, Cree MJ, Olson JA, McHardy KC, Sharp PF, Forrester JF. A comparison of computer based classification methods applied to the detection of microaneurysms in opthalmic fluorescein angiograms. Comput Biomed Res. 1998;28:225-38.

[11]. Gardner GG, Keating D, Williamson TH, Elliott AT. Automatic detection of diabetic retinopathy using an artificial neural network: a screening tool. Br J Ophthalmol. 1996;80(11):940-4.

[12]. Ege BM, Hejlesen OK, Larsen OV, Moller K, Jennings B, Kerr D, Cavan DA. Screening for diabetic retinopathy using computer based image analysis and statistical classification. Computer Methods Programs Biomed. 2000;62(3):165-75.

BIOGRAPHIES

Netra Yaradoni is currently persuing M.Tech in Computer Science and Engineering from the Alva's Institute of Engineering & Technology, Mijar, Moodbidri, Karnataka, India.

Mr. Manjunath R Raikar is currently working as Assistant Professor, Department of Computer Science and Engineering from the Alva's Institute of Engineering & Technology, Mijar, Moodbidri, Karnataka, India.