Detection of Systematic and Retinal Diseases Using IPACHI Model

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ABSTRACT

We propose a method for detection of systematic diseases and retinal diseases using IPACHI model. The segmentation of blood vessel in retinal images support early detection, diagnosis, and optimal treatment. Various systematic diseases such as Hypertension, Stroke, Diabetes, Cardiovascular diseases and retinal diseases such as Glaucoma, Retinal Detachment, Retinitis Pigementosa, Macular Pucker, Cataract ,Branch retinal vein occlusion (BRVO), Branch retinal artery occlusion (BRAO), Central retinal vein occlusion (CRVO), Central retinal artery occlusion (CRAO) are recognized based on the features and MAs. Fundus images are categorized based on these features using different classifiers

Key Words: IPACHI, Morphological operation, Pre-Processing, Segmentation

1. INTRODUCTION

Human body is a structure of human being, and action take place with the help of brain. The overall shape of body does not alter much over lifetime. From the top to bottom blood circulated with help of different blood vessels including arteries, veins and capillaries. Vein helps to carry blood towards the heart or carry deoxygenated blood from tissues. Artery has just opposite function, to carry blood away from the heart or carry oxygenated blood. The smallest blood vessels and are part of microcirculations which is known as capillaries . Capillaries help to exchange of Water, CO2, oxygen and other nutrients. Blood vessels control the functioning of body and are in linear structure. Any variations or damage to blood vessels increase complication levels in our body.

Computer aided diagnosis (CAD) now a day's most widely used for image analysis.CAD increase efficiency and safety to handle high resolution images. Segmentation is generally partitioning image into group of pixels which are homogeneous, the process of dividing image into meaningful regions. Blood vessel segmentation helps clinical support for early detection, diagnosis and treatment. Vessels enhanced by kernels to solve segmentation problems.

The segmentation techniques broadly classified into supervised and unsupervised segmentation. Supervised segmentation need an operator support throughout the process, e.g. support vector machine (SVM), Gaussian mixture models (GMM), K-nearest neighbours, Artificial neural network (ANN), AdaBoost, and Conditional random fields (CRFs). In unsupervised segmentation need of the operator after process only, so that can be used wide range of imaging applications. Thresholding technique is most common example for unsupervised segmentation, and major problem is only two classes are generated, cannot apply to multi channel images. They are very sensitive to noise and intensity in homogeneities. To eliminate vessel segmentation problems many number of active contour models proposed including Ribbon of twins (ROT), CV Model (Chan - Vase), Geodesic active contour(GAC),and Distance regularization level set evolution (DRLSE).

A new approach Infinite Perimeter Active Contour Model with Hybrid Region Information i.e. IPACHI, can taken into account the geometry information and intensity information. Infinite perimeter regularization best suited for detection of small oscillatory structures. The proposed method uses retinal images for detection of different diseases. A disease effect on body, changes occur in the small blood vessel like retina. Retinal images are well established

datasets available for research and application. The datasets are golden standards for developing new segmentation algorithms. Retinal blood vessel segmentation and analysis important to detect systematic diseases such as Stroke, Diabetes, Cardiovascular Diseases, Hypertension and retinal diseases such as Glaucoma, Cataract, Retinal Detachment, Retinitis Pigmentosa, Macular pucker, Branch retinal artery occlusion (BRAO), Branch retinal vein occlusion (BRVO), Central retinal artery occlusion (CRAO), Central retinal vein occlusion (CRVO). In this paper section 2 provides an overview of different diseases, section 3 details about our proposed system, and section 4 shows the experimental results and section 5 concluded result of proposed system.

2. RELATED WORK

The section will give a brief idea about all the systematic diseases and retinal diseases.

2.1 Diabetes

Diabetes is a chronic end organ disease that occurs when pancreas does not secrete enough insulin. diabetes effects eye, nerves, heart, and kidney. Diabetic Retinopathy (DR) affects blood vessels in the light sensitive tissue called retina, which makes vision loss and vision impairment. Diabetic Macular Edema (DME) is swelling in an area of retina called macula. diabetes makes changes to blood vessels, i.e. leaky blood vessels, swelling of macula, changes in the lens and damage to nerve tissue. Ophthalmologists recognize diabetic retinopathy based on features, such as blood vessel area, exudes, haemorrhages, MAs and texture. The major causes of diabetes are obesity, life style, age and family history. The different stages of diabetes include normal, mild, moderate, severe and proliferative.

2.2 Hypertension

Hypertension can occur with uncontrolled high blood pressure causing damage to the light sensitive tissue at back of eye, i.e. retina. Blood vessels in the back of eye become thick and hard, keeping blood and nutrients from travelling to the retina. The weakened vessels also swell or leak, cause bleeding in eyes and leads to blurred vision or vision loss. Major symptoms are headaches, blurred vision, blind spots and sudden vision loss. By regular eye check up disease is recognized otherwise serious vision loss occur. Hypertension classified into different grades, Grade 1 having AV Ratio 50%, Grade 2 having AV Ratio 33%, Grade 3 having AV Ratio 25%, and Grade 4 having AV Ratio less than 20%.Laser surgery is the best option to restoring vision loss.

2.3 Stroke and Cardiovascular Diseases

Stroke is known as cardiovascular accident (CVA), when poor blood flow to the brain result in cell death. The brain cannot function properly, due to this inability to move and feel, problem to speak and understand capacity. Major risk factors include high blood pressure, obesity, tobacco, alcohol and drug usage, lack of physical activity. Stroke is classified into ischemic and haemorrhages. Cardiovascular diseases change width of vessel i.e. decrease width of arteries, increase width of veins. A small change in arteriolar to venular diameter ratio (AVR) increases the risk. In clinical applications estimating AVR from the retinal images.

2.4 Glaucoma

Glaucoma is condition cause damage to eye's optical nerve, due to build up of pressure inside the eye, so block transmission of images. The high pressure continues glaucoma will cause permanent loss of vision. Age, family history, diabetes and other risk eye diseases are the causes of glaucoma. Due to this large pain and redness in eye, seeing halos around lights, vomiting, narrowing of vision, at last complete vision loss. Eye drops, Laser surgery and Micro surgery are used to the treatment process.

2.5 Cataract

Cataract makes clouding of eye's lens. The patients with diabetes having high chance of cataract.

2.6 Retinal Detachment

Retinal Detachment disorder of eye in which retina peels away from the supporting tissue. Permanent damage occurs if detachment is not repaired within 24 – 72 hours. Glaucoma, Cataract surgery, Diabetic retinopathy, Family history and Smoking are the risk factors.

2.7 Retinitis Pigmentosa

Retina has pigment deposits known as bone spicules and result in loss of photoreceptors. The major problem is difficulty seeing at night, loss of central vision and gradual loss of peripheral vision. Electro Retino Graph (ERG) and dilated eye exam are used to detect the disease.

2.8 BRVO, BRAO, CRVO and CRAO

Branch retinal vein occlusion, Branch retinal artery occlusion, Central Retinal vein occlusion and Central retinal artery occlusion are the disease of eye, where blood flow through vessels blocked. Hypertension, diabetes, glaucoma, obesity, smoking and age are the major risk factors. Variations and block in vessels detected by angiography and visual field testing.

3. MATERIALS AND METHODS

Section 3 gives the steps of vessel segmentation. The architecture of vessel segmentation algorithm shown in figure 1.

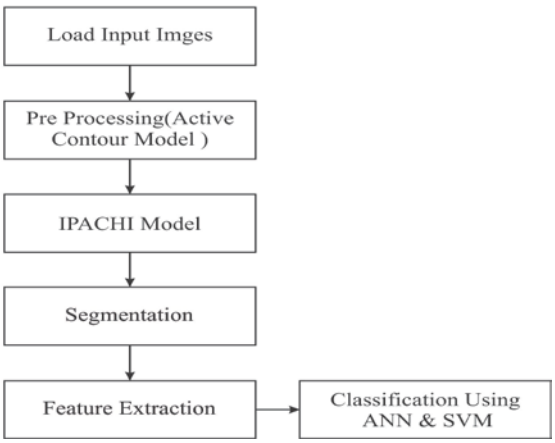

Figure 1 Vessel Segmentation Algorithm

3.1 Retinal Images

Retinal images are the input. The main reason for using retinal images are well established datasets and take as benchmark for developing new algorithms for segmentation. By analysis of retinal images diseases can be detected.

3.2 Pre-processing

The Pre-processing stage active contour models used. Active contour model is frame work to detect object outline from possible noisy 2D images. ACM used for improving accuracy and performance.

3.3 IPACHI Model

IPACHI Model used for detection of small oscillatory structures . Infinite perimeter Regularization model suited to detect vasculature structures. New model having integration of different region information such intensity and local phase map. The local phase map has positive values inside vessels, negative values in background and zero values at the edges of structure.

3.4 Segmentation

Segmentation is the process of partitioning a digital image into multiple segments. Image segmentation typically to locate objects and boundaries. The result of segmentation is a set of segments, collectively cover entire image. Each pixel in a region similar with respect to some characteristics such as colour, intensity, or texture. Analysis input image, a threshold value selected, a zero matrix mask is created and superimposing mask to input images.

3.5 Feature Extraction

Feature extraction is the process of extracting required data. Starts with initial set of measured data and builds derived features**.** Reducing the amount of resources to describe large set of data.

3.6 Classification

Classification performed with two types of classifiers, Support Vector Machine (SVM), Artificial Neural Network (ANN).

Support Vector Machine (SVM) is the learning algorithm, to analyze data and recognize pattern for classification. Representation of example points in space mapped, so point divided into separate categories by clear gap.

Artificial Neural Network (ANN) is an interconnected group of nodes, like neurons in a brain. Neural network gives idea about different stages or amount of detection.

4. EXPERIMENTS AND RESULTS

In this section we evaluate the performance of our model by using retinal images. All experiments were performed in Mat lab version 2014a. Retinal image turns to RGB image, select green channel component due to high intensity value. Boundary detection of vessel with the help morphological operation. The channel extracted retinal image shown in figure 2.

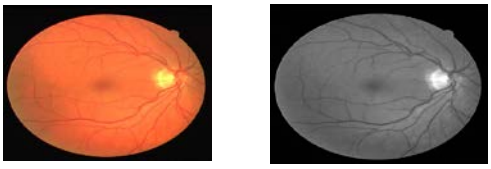

Figure 2 Input Images and Green Channel Image

In order to extract thin and thick vessels in retinal images Gaussian curve filtering required. Figure 3 shows Gaussian filtered retinal image.

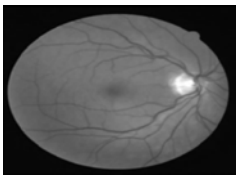

Figure 3 Gaussian Filtered Retinal Image

Microaneuryms (MAs) are tiny swelling in the wall of blood vessel. It appears in retinal capillaries as a small, round and red spot. MAs remain stable over time, but only 29% remain at the same place. Figure 4 shows MAs detection, from the RGB fundus image.

Figure 4 Detected Microaneuryms

From the vasculature structure of retinal images features extracted and classify accordance with the classifier. Figure 5 shows the vasculature structure of retinal images.

Figure 5 Input Images , Grey Scale Image and Vasculature Structure of the Input Image.

5. CONCLUSION

Segmentation of blood vessel still one of the challenging problem in medical images. Many factors like noise blur effect different medical imaging techniques. IPACHI Model solve vessel segmentation problem by taking different region information. This model suited to avoid segmentation problems in different techniques like X-Rays, MRI, and CT. Detection and stages analysed using different classifiers.

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