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An approach to classification of retinal vessels using neural network pattern recoginition

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Abstract— Artery/Vein classification of retinal vessels is a key phase in detecting automatic vascular changes. Retina is a layer, found at the back of eye ball which when damaged may leads to severe problems. Retina plays a vital role in visualization. There are two kinds of blood vessels in vascular system. They are Artery and Vein. Analysis of vascular system leads to early detection of diseases like hypertension diabetes retinopathy, cardiovascular condition, etc. Therefore, we proposed an automatic early detection of diseases by classifying Artery/Vein which resides on functionality of graph. We used Neural Network Pattern Recognition from MATLAB for classification. Graph is extracted from segmented retinal images from which the features are extracted. Morphological operations are performed on segmented retinal images. Center lines are identified using graph based approach. Then, feature extraction is performed, which is classified by neural network pattern recognition classifier in order to obtain best accuracy in classifying normal or abnormal Artery/Vein.

Keywords—Retinal Vessels; Neural Network; Segmentation; Artery/Vein; Pattern Recognition.

I. INTRODUCTION

Retina is a sensitive tissue layer which is seen behind the eyeball. It helps in observing the scenes and moves. Macula is a small portion in retina that has light sensitive cells which helps to see the minute particles with clarity. Retina vessel disorder may leads to many severe diseases such as diabetics which can be diagnosed by utilizing retina images. Arteries are bright and veins are dark in nature. Arteries transport blood rich oxygen and vein blood low oxygen. Blood vessels are segmented before classifying artery or vein. Central reflex is wider in arteries while it is small in veins.

II. LITERATURE SURVEY

Classification of Eye Movements Using Electrooculography and Neural Networks was proposed by Hema et al [1] where they proposed algorithms for classifying eleven eye movements acquired through electrooculography using dynamic neural networks. Signal processing techniques and time delay neural network were used to process the raw signals to identify the eye movements. Feature extraction algorithms were proposed using the Parseval and Plancherel theorems. The performances of the classifiers were compared with a feed forward network, which encouraged with an average classification accuracy of 91.40% and 90.89% for time delay neural network using the Parseval and Plancherel features.

Classification of Pathology in Diabetic Eye Disease was proposed by Jelinek et al [2] where they presented the utility of pattern analysis tools linked with a simple linear discriminate analysis that not only identifies new vessel growth in the retinal fundus but also localizes the area of pathology. Ten fluoresce in images were analyzed using seven feature descriptors including area, perimeter, circularity, curvature, entropy, wavelet second moment and the correlation dimension. Features like area or perimeter measures of neovascularisation associated with proliferative retinopathy were not sensitive enough to detect early proliferative retinopathy. The wavelet second moment provided the best discrimination with a SNR of 1.17. Combining second moment, curvature and global correlation dimension provided a 100% discrimination (SNR = Inf).

Graph-Based Algorithm for Differentiating Artery/Vein & Registration of Retinal Images was proposed by Vinayak et al [3] where they proposed a way to separate artery and vein based on analysis of graph extracted from retinal tree, which was an important phase for automating the detection of vascular changes & calculation of characteristic signs associated with several systemic diseases as well as image registration to DB system.

Graph-Based Approach for artery/vein classification of systemic diseases in retinal images was proposed by Tharangani et al [4] where they proposed A/V classification which completely resides on the graph functionality which is extracted from the retinal micro vasculature. Classification of entire vascular tree is performed and fixed the type of intersection point. The concluded AV vessel segment classification is performed through the partnership of a set of feature intensity and the graph-based labeling results.

Effects of Preprocessing Eye Fundus Images on Appearance Based Glaucoma Classifcation was proposed by Meier et al [5] where they presented a novel automated classification system based on image features from fundus photographs which does not depend on structure segmentation or prior expert knowledge.

Classification of Retinal Vessels into Arteries and Veins - A Survey was proposed by Maheswari et al [6], where they proposed various methodologies for classification of retina image into artery and vein which were helpful for the detection of various diseases in retinal fundus image. They calculated mean diameter of arteries and veins.

Retinal Images Classification using Graph-Based approach for Disease Identification was proposed by Divya et al [7] where they presented an automatic approach for Artery/Vein classification based on the analysis of a graph extracted from the retinal vasculature. The graph extracted from the segmented retinal vasculature was analyzed to decide on the type of intersection points (graph nodes), and afterwards one of two labels was assigned to each vessel segment (graph links). Final classification of a vessel segment as A/V was performed through the combination of the graph-based labeling results with a set of intensity features.

III. METHODOLOGY

The following fig 1 represents the diagrammatic representation of Artery/Vein Classification. Automatic artery/vein classification is performed by incorporating Graph based method. Retinal images are segmented from which the graph is extracted. This extracted graph is analyzed with respect to intersection points and vessel segments. Intersection points are graph nodes. Vessel segments are graph links. Vessel segments are measured to detect intensity features which are useful in classification of artery and vein. Entire vascular tree is classified with respect to type of graph nodes and assigns labels to graph links. ODC (Optic Disk Centre) is used to locate link labeling by automatic method of entropy. In existing work, “Vessels Classification in Retinal Images by Graph-Based Approach” was proposed by Divya et al [8] where they used KNN for classification of retinal images as artery and vein.

Neural Network is an Artificial Intelligent technique which is developed by the inspiration from biological nervous system. It is highly interconnected, parallel, distributed and massive collection of neurons. It incorporates mapping capabilities or Pattern Recognition, generalization, robustness, Fault tolerance, etc. Neural Network learns by examples. In this research work, neural network pattern recognition is used for classification. Images are used as input, graphs are detected, and features are extracted. Extracted features are classified in Neural Network Pattern Recognition.

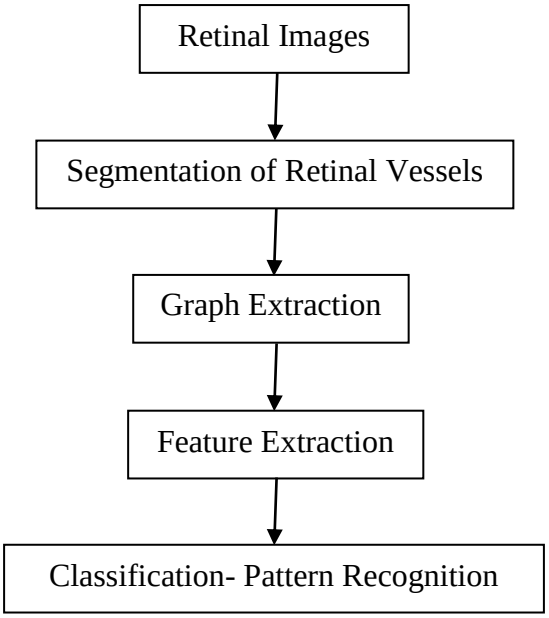

Fig 1: Systematic Artery/Vein Classification

3.1 EXPERIMENTAL RESULTS

Retinal images are given as input. Segmentation is performed on retinal images. Features are extracted on detected graphs. These Extracted features are classified using pattern Recognition. Fig 2 shows a confusion matrix contains information about actual and predicated. Classification done by a classification system. Performance of such a system is commonly extracted using the data in the matrix. The following table shows the confusion matrix for a two classifier. It measures accuracy of two classes' artery & vein. In existing work KNN (K-Nearest neighbor) classifier was used to classify retinal images as artery and vein. In proposed work Neural Network pattern Recognition is used to classify retinal images as artery and vein. In existing classifying work 93% accuracy was obtained. In Proposed work 95% accuracy is obtained with pattern recognition.

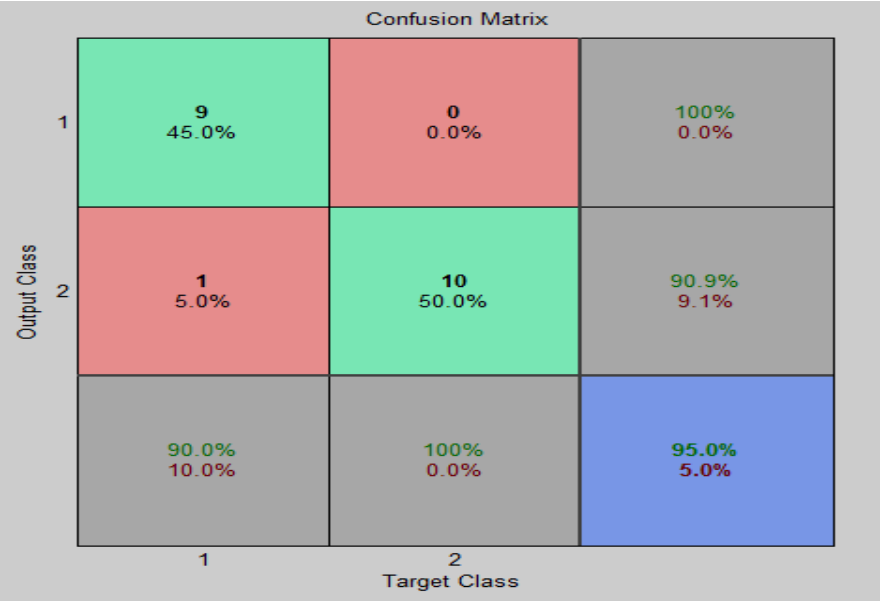

Fig 2: Confusion Matrix

Confusion matrix is a matrix used to find the performance of classifier. Accuracy of Pattern Recognition neural network classifier is analyzed in this confusion matrix. Various other evaluations metric such as Precision and Recall can be analyzed from this confusion matrix.

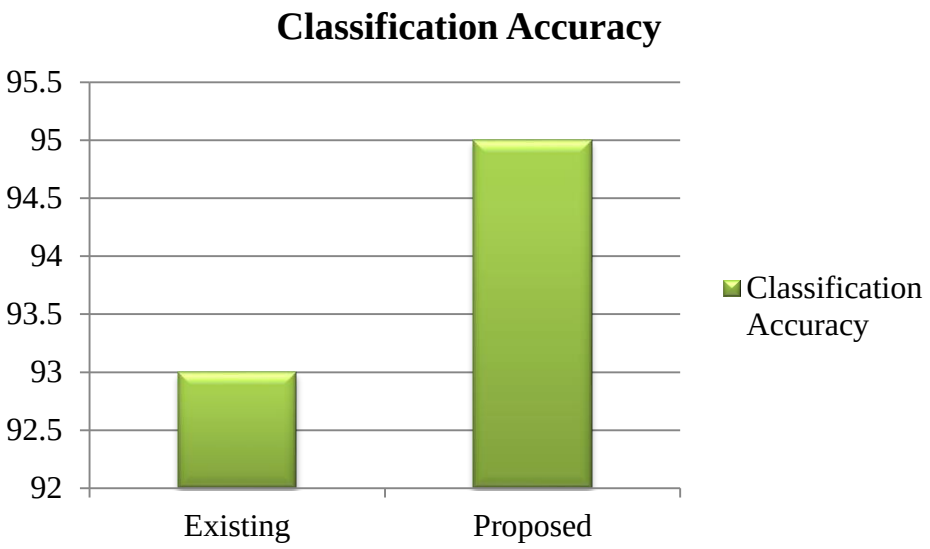

Fig 3: Classification Accuracy

IV. CONCLUSION

Automatic assessment of vascular changes is done by classification of arteries and veins in retinal images. Additional information from vascular network was obtained. Graph analysis is done with respect to node degree, orientation of each link, and vessels calibrations. Graph based approach with neural network pattern recognition classification provides best accuracy (95%) of classification of Artery/Vein. Graph based feature extraction is performed on segmented retinal vessels which is extracted as features for classification. This approach, used in classifying various diseases accurately.

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