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ANTERIOR SEGMENT OPTICAL COHERENCE TOMOGRAPHY

Ophthalmology

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ABSTRACT

Effective feature selection plays a vital role in anterior segment imaging for determining the mechanism involved in angle-closure glaucoma (ACG) diagnosis. The aim of this project is to use anterior segment (AS- OCT) optical coherence tomography images to diagnose complicated diseases like Angle Closure Glaucoma. The collected input images are subjected to pre-processing. In the Pre-processing step, Sobel filter is implemented. In the feature extraction process, it implements the canny edge and Sobel is applied to extract the feature. In the feature selection process, we can apply the Watershed algorithm. In this step to implement it, the Naive Bayes Classifier is used. Naive Bayes classifiers are highly scalable, requiring some parameters, linear in the number of variables (features/predictors). Finally analysis of the performance of the process to find the TP, TN, FP, FN, Accuracy, Precision and recall is done. It has been shown that the accuracy in diagnosis of Angle Closure Glaucoma was better using L-Score method as compared to MRMR method.

KEYWORDS

Sobel Filter, Watershed, L-Score.

1 INTRODUCTION

GLAUCOMA is a chronic progressive optic neuropathy due to a raised intraocular pressure (IOP), which causes damage to the optic nerve fibres and astrocytes resulting in loss of vision. It is essential to detect glaucoma in its early stages in order to preserve a patient's vision. Detection of glaucoma is time consuming and needs special skills and devices. Diabetic eye disease refers to a spectrum of eye conditions that is manifest in people with diabetes.

Glaucoma can be classified mainly into two types: closed angle glaucoma and open angle glaucoma. The angle between the root of the iris and the corneal periphery is the key featue which distinguishes Open Angle Glaucoma (OAG) and Closed Angle Glaucoma (CAG).

When this angle is wide open, it said to be OAG and when it is narrow or closed, it is CAG. Angle refers to the region where the iris and cornea meet , through which fluid from anterior chamber drains out of the eye. There is a soft mesh-like tissue at this juncture, which serves as a filter during the evacuation of aqueous humor. In open angle glaucoma, the angle is open but aqueous drainage is hampered at the microscopic level. In closed angle glaucoma, the angle is narrow and aqueous flow is hindered. This causes a build up of pressure in the eye resulting in ACG. Narrow angle patients may suffer rapid onset of symptoms and are at a high risk of angle closure attacks. The Fig (1) highlights the difference between the open and closed angles.

Glaucoma may also be classified into three major divisions - angle-closure glaucoma (ACG), open-angle glaucoma, and developmental glaucoma. Each class is further subdivided into primary and secondary glaucoma. Of these, OAG are chronic and asymptomatic, and are more prevalent. ACG causes more visual morbidity than open-angle glaucoma.

The usage of Optical coherence tomography (OCT) in the diagnosis of glaucoma has proven to be beneficial. It's non-contact nature, is very convenient for usage to measure the distance and angles between the various anatomical structures, within the eye, using near-infrared light.

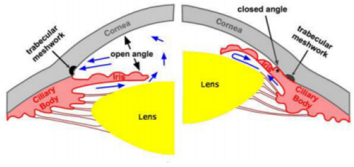


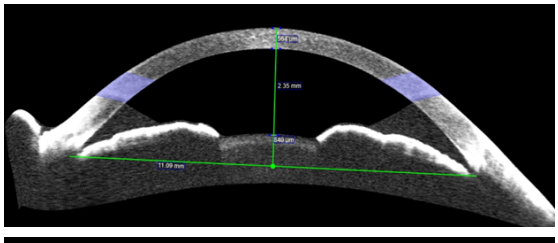
Fig-1: Open Angle and Closed Angle Glaucoma.

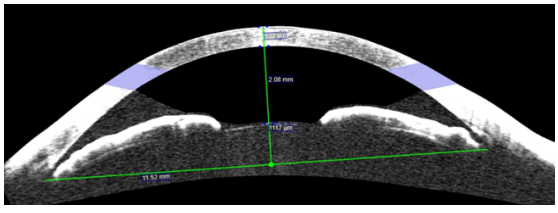
It is important to reliably detect the features of intraocular structures from the AS-OCT images. This will improve the classification accuracy, as the detected features are the basis of glaucoma detection. This has been less investigated.

The motive of this study is to analyse two different methods of selection of features, from the anterior segment of the eye. This will provide a better understanding of the use of selective redundant features for machine classification, which will improve the chances of accurately diagnosing glaucoma. This paper gives a detailed analysis and compares the results, in terms of their accuracy and F-measure for possible interpretation. The purpose of the study is to understand glaucoma detection, classification, and analysis using less commonly used features of AS-OCT imaging. The subsequent machine classification demonstrates the effectiveness in identifying the different mechanisms of ACG.

Symptoms of angle closure glaucoma include hazy or blurred vision, the appearance of rainbow-colour circles around bright lights (halos), severe eye and head pain, vomiting and sudden loss of sight.

In general, glaucoma occurs due to, failure of the eye to successfully maintain a balance between the amount of intraocular fluid produced and the amount that drains away. When something deranges the regulation of intraocular fluid, eye pressure can rise to high levels and cause glaucoma. This rise in pressure, damages the optic nerve, causing loss of vision and eventually blindness.





2 LITERATURE SURVEY

Many methods are used to analyze glaucoma using OCT images. Effective feature selection methods are used to determine the mechanisms. [1].Georg Michelson, Joachim Hornegger provides a data driven framework extracting a novel glaucoma parameter from fundus image. The methodology can be transferred to other domains and extract further parameters providing new values for the images. [2].According to Alin Achim, James E Morgan describes a new method for automated texture classification for glaucoma detection using high resolution Optical Coherence Tomography. To improve classification, accuracy and the information from visual fields can be used for early glaucoma detection. [3].Swamidoss Issac Niwas, Chee Keong Kwoh uses the L-Score method to improve the angle closure glaucoma detection, and then compared minimum redundant features by MRMR method. It also focused on the correlation between the mechanisms of angle closure identified, with the help of the feature selection. [4]. Cho-Huak Roland T. Chin evaluates a number of moments and addresses some image representation ability and noise sensitivity. If the noise level is too high in the first segment, the original image is used and extract moments from the segmented image. [5].Robert M. Haralick, K. Shanmugam describes some easily computable textural features based on the gray-tone dependencies. A set of features can be classified for pictorial data. [6].Saksham Sood, Arif Arman proposes a method Optical character recognition is used for extracting the data. Cross-validation is a technique which is used to protect the data. [7]. Srinivasan C, Dr Ganeshbabu TR proposes an efficient approach for glaucomatous image classification system using fundus image. This system provides classification accuracy while using hybrid features. [8]. Paul T.K. Chew focuses on the use of redundant features for complex disease diagnosis. The correlation between the mechanisms of angle closure glaucoma are identified using feature selection.

3 BLOCK DIAGRAM

Images are given as input images; they are train and test images. In this paper, there are five steps to identify the glaucoma diseases and rectify it. In each step the processing methods vary and help to identify the accuracy level for that disease.

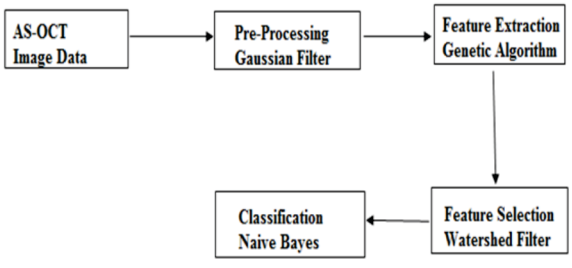


Fig 3.1: Block diagram

3.1 Pre-processing

In Pre-processing stage preparing the image for , since image quality varies according to the conditions of acquisition. For instance, the image could be acquired under some undesired conditions, such as unevenly illuminated, noisy or low-contrasted images, which obviously influence the performance of the segmentation algorithm.

3.2 Feature Extraction

In this stage, the features are extracted from the image via canny edge and sobel filter. In the canny edge, filter is used to smooth the image, to remove the noise and find the intensity of the image. Next sobel filter is particularly within edge detection algorithms where it creates an image emphasising edges.

3.3 Feature Selection

In the feature selection stage it uses a genetic algorithm. For this, algorithms are commonly used to generate high quality solutions to optimization and search problems by relying on bio-inspired operators such as mutation, crossover and selection.

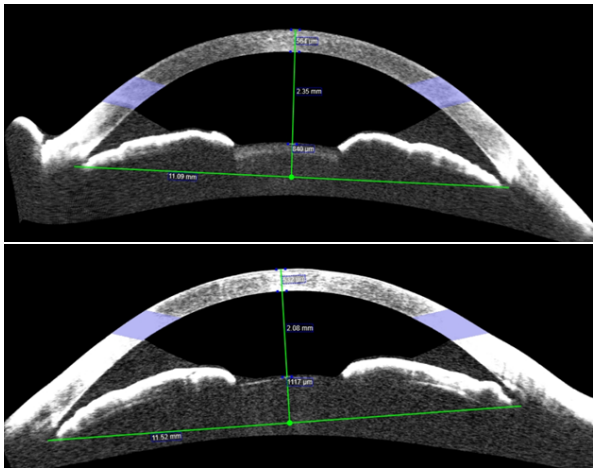
3.4 Classification

This probabilistic classifier directly applies the Naive Bayes rule to determine the probability of a test sample belonging to a class. Three assumptions are made: the feature data is normally distributed, the predictive attributes are conditionally independent, given the class, and no hidden or latent attributes influence the prediction process.

3.5 Performance Measure

The performance matrix includes accuracy of True Positive, True Negative, False Positive, False Negative and Precision value. The maximum accuracy of 92% is obtained in this system.

$$\text{Accuracy} = \frac{TP+FN}{TP+TN+FP+FN}$$



4 CONCLUSION AND FUTURE WORK

In this paper, an automatic anterior chamber angle structure segmentation method is proposed, in AS-OCT images. The key contributions of this work are the segmentation of the Anterior Chamber Angle major structures and introduction of the label transfer to generate the initial labels to be used in this method. There are several potential applications of our proposed method: ACA parameter measurement, clinical anatomical assessment, automatic angle closure glaucoma classification, and large clinical dataset analysis.

In future, work may be done to extend the framework, by combining the various clinical parameter measurements, for automatic angle-closure glaucoma diagnosis. The future direction, regarding detection of glaucoma can be, evaluation of the various algorithms discussed in this paper, by implementing and testing them on large amount of data.

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