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Detection of Glaucoma Disease Using CBIR and Relevance Feedback Algorithm

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***Abstract*— The recent advance in glaucoma classification method and improvements in the accuracy of classification. Glaucoma is the worst eye disease it results into permanent blindness so to avoid blindness early detection of glaucoma is essential. Our research is focused automated classification system for the identification of disease . In this paper we use relevance feedback algorithm. This algorithm is an effective in bridging the gap between high-level semantics and low-level features in content-based image retrieval. In contrast to previous methods which rely on labeled images provided by the user, this paper enhance the performance of different classifiers to detect glaucoma eye disease. In The effectiveness is gauged of the resultant ranked and selected subsets of features using a support vector machine, sequential minimal optimization, random forest, and na¨ıve Bayes classification techniques.. We observed an accuracy of around 95.23% using SVM classifier.**

Keywords*— *Glaucoma; feature extraction; image texture; wavelet transforms; biomedical optical imaging.

I. Introduction

Glaucoma is nothing but one of the eye disease that is cause due to elevated intraocular pressure, in which the eye (optic) nerve get damage and can lead to loss of vision and even peripheral blindness. Glaucoma gets worse over time because it directly damage to your eye's optic nerve. It's always associated with a buildup of pressure inside the eye. Glaucoma is inherited and may not show it's symptoms until later in life. The optic nerve get damage because of increased pressure, called intraocular pressure, which transmits images to the brain. If damage to the optic nerve due to high eye pressure continues, glaucoma will results in permanent loss of vision. Without treatment, glaucoma can cause complete blindness within a few years. Because most people having glaucoma not feeling early symptoms or pain from this increased pressure, so to avoid long-term visual loss it is important to check your eye from doctor regularly so that glaucoma can be diagnosed . It is estimated that if age is over 40 and have a family history of glaucoma disease. Inside the eye fluid flows through a mesh-like channel, this fluid is known as humor . If this channel is blocked then fluid builds up and this fluid is not circulating normally in the front part of the eye it causing glaucoma. Glaucoma usually occurs when pressure in your eye increases. Glaucoma passed from parents to children means it is inherited. Glaucoma usually occurs in both eyes, but it may have different extent in each eye. Open-angle and Angle-closure glaucoma are main two types of glaucoma.

Open-angle glaucoma. it's main symptom is that eye structures appear normal, but the flow of fluid inside the eye is not proper through the eye drains, called the trabecular meshwork[11]. Angle-closure glaucoma. It is also called acute or narrow-angle glaucoma. In this case the angle between the iris and the cornea is too narrow and physically blocked by the iris it results into poor drainage. This cause to a sudden buildup of pressure in the eye[11]. Having had serious eye trauma, having a family history of glaucoma.Under rare circumstances, certain drugs can increase the risk of developing glaucoma. For example certain over-the-counter cold remedies, seizures, or drugs for bladder control, can increase glaucoma risk. If vision lost due to glaucoma cannot be restored. There is no cure for glaucoma disease. So it is necessary to detect glaucoma as early as possible.

CBIR is a technique used to retrieve images from database of an image such that the retrieved images are semantically relevant to a query image provided by a user. For representing imags, it used low-level visual features and these features can be automatically extracted from images, which reflect the color, shape and texture information of the image. However, the gap between the low-level visual features and the high-level semantic meanings results into poor performance.

Fig. 1.Example[10]

Now what is about semantic gap so above fig.1 shows an example for semantic gap. The left most is a query image of fig.1, if we given this image as input and want to retrieve all images that are matching to query image. Then some users focus on the sea beach so the middle image is best matchto query image ; while others think or may focus on the coconut tree, so the right most image is the best match. This problem is come under semantic gap. A question that naturally emerges is, what can we do to deal with these problems? The answer is to introduce the users in the process, having them interacting and telling what is really relevant for the images being retrieved and analyzed. Therefore, by gathering the user's indications, algorithms can be developed to change the placement of the query, or to change the similarity function employed in order to better comply with the user's expectations. The approach that asks to the user to set the relevance of the images to a given query and to reprocess it based on the user's feedback is called ***relevance feedback*** (***RF***), and is been proven to be quite effective in bridging the semantic gap.

Section II describe the related work of glaucoma classification and classification techniques using discrete wavelet transform. In section III dataset used for the glaucoma classification is explained in detail. Section IV contains the architecture of glaucoma classification system. Section V describe Methodology and will Finally we make conclusions in Section VII.

II. Related Work

To detect or diagnosis the disease glaucoma, efforts are made from many years, so that the extent of causing glaucoma disease can be reduced or even fully cured. To analyze functional abnormalities of the eye especially glaucoma the optical coherence tomography [1] and multifocal electro retinograph (mfERG) are prominent methods employed. mfERG provides the detailed topographical information of each and every zone which can be helpful in detection of small-area local lesions in the retina along with in its central region (fovea). mfERG signals are analyse by the discrete wavelet transform (DWT) [2] and detect glaucoma.To identify disease pathology in human eyes, CDSS[3] [4] are used efficiently to create a decision support system in ophthalmology .In CDSS, both texture and structural features of images are extracted.In which rim area, disk area, cup to disc ratio and topographical features are include in structural features. By calculating cup to disc ratio [5], glaucoma diagnosis automatically. The ratio of the vertical cup height divided by the vertical disc height is known as CDR (Cup-to-Disc Ratio). A Cup-to-Disc Ratio value that is greater than 0.65, it indicates high glaucoma risk. The enhancement of optic cup to disc ratio improved glaucoma diagnosis[6]. The enhancement is done such that the least square fitting is used to determine boundary of cup and disc. The POD method is used to identify glaucoma progression from textural features [7]. Glaucoma always get damages the optic nerve head (ONH) and ONH changes occur prior to visual field loss. Thus, to detect the onset and/or progression of glaucoma, digital image analysis is a promising choice by using the method of proper orthogonal decomposition (POD). For glaucomatous image classification texture features and higher order spectra[8] [9] can also be used. Feature extraction is done using wavelet decomposition and the support vector machine, random-forest, sequential minimal optimization and naive Bayesian classifiers are used for classification.

MATERIAL USED

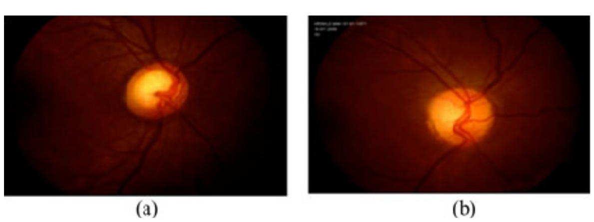

Fig. 2. Typical fund images of eye(a) normal and (b) glaucoma[8]

The digital images of retina were collected from High Resolution Funds (HRF) image database (https://www5.cs.fau.de/research/data/fundus-images/) We have used 30 fundus images out of which 15images are normal and 15 glaucoma images. All the images were stored in jpeg format.

III. Architecture Of Glaucoma Classification

Fig.3 shows the block diagram for classification of Glaucoma and Normal Retinal Image. Following are the steps to follow for classification of glaucoma images. it shows the overall working of system.

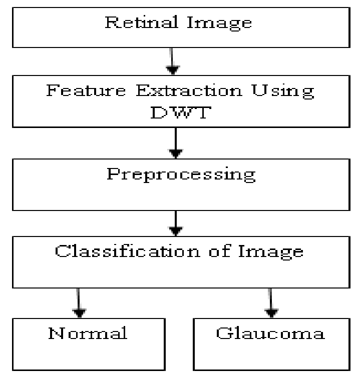

Fig. 3. Block diagram of Classification as Glaucoma and Normal Retinal Image

IV. Methodology

The dataset contained 30 images , these images were given to the standard histogram equalization. Histogram equalization is used for assigning intensity values of pixels in the input image, so that the output image contained a uniform distribution of intensities as well as it increase dynamic range of the histogram of an image.

A. CBIR

Content-based image retrieval (CBIR) systems use low level feature vectors, e.g. measures of color, texture, and shape, to express the visual content of images . Once prescribed, these features are calculated from the set of images to be searched, and then stored in a reference file. The art , and the inherent difficulty, in constructing an effective CBIR code is to try to devise a set of feature vectors that most succinctly represent the higher level features that are important to the user[10].

B. Relevance feedback algorithm

In 1990s the concept of relevance feedback was introduced into Cbir from the text-based information retrieval and then became a popular technique in Content-based image retrieval. This is not strange because images are more ambiguous than texts, making user interaction desirable. With relevance feedback, a user can label a few more images as new examples for the retrieval engine if he or she is not satisfied with the current retrieval result. Actually, these new images refine the original query implicitly, which enables the relevance feedback process to bridge the gap between high-level image semantics and low-level image features. There is a good recent review on relevance feedback. Relevance feedback algorithm proposed an *interactive* retrieval approach to image data mining. This approach attempted: (1) to fill the gap between low level features and high level visual concepts, and (2) to use the subjectivity of the human perception of images, against a limited number of retrieved images, to improve the search process. In this RF approach, dynamically updated feature and feature weights, based on user feedback in the retrieval process, capture the user's high level query and perception subjectivity[10].

Classification

Classification of glaucoma and normal images is done using various classification techniques. Classification of selected subsets of features is done using a support vector machine, random forest, sequential minimal optimization, and naïve Bayes classification strategies.

V. Results

Once the features are subject to both categories of feature ranking and/or feature selection, we apply Content-based Image Retrival and then perform the classification using SVM, SMO, Random forest and Na¨ıve Bayes classifiers. When we apply Relevence Feedback algorithm we get better result than previous i.e using CBIR if we 9 images as output out of 15 images instead of that 11 or 12 images retrived as output by using relevance feedback algorithm .

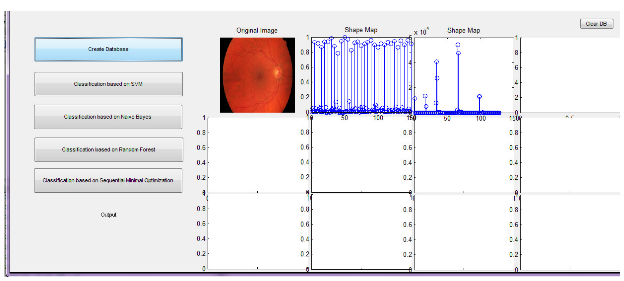

Fig. 4. Histrogram of Image

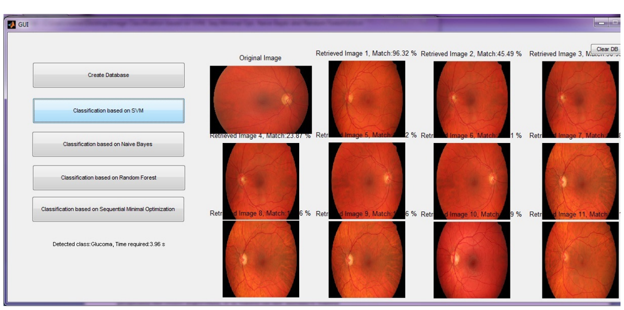

Fig. 5. Classification using SVM, SMO, RF, NB

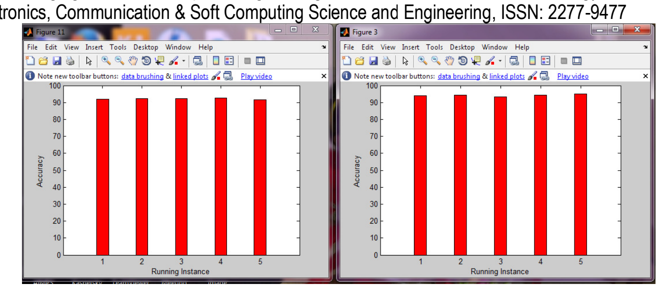

Fig. 6. Graph for SVM and Na¨ıve Bayes Classifiers

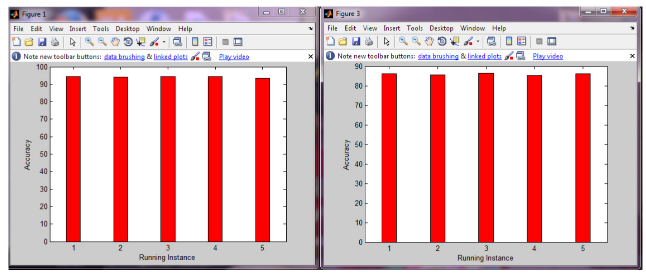

Fig. 7. Graph for SMO and Random Forest Classifiers

TABEL I. Classification accuracies obtain

Classifier	Feature Ranking & Feature Selection — Relief & Greedy Stepwise	Relevance feedback Algorithm
SVM	94.26	95.23
SMO	90.20	91.33
Na¨ıve Bayes	90.82	91.12
Random Forest	87.20	88.24

Conclusion

Summarizing we can say that glaucoma classification has various phases as image decomposition, preprocessing, feature extraction and classification. The ranked subsets of selected features have been subjected to a set of classification algorithms to gauge the effectiveness of these features. From the accuracies obtained we can conclude that to differentiate

the normal and glaucoma image, energy obtained from the detailed coefficients can be used. From the five number of iteration we can conclude that SVM present highest accuracy of 95.23% using relevance feedback algorithm.

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