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Diagnosis Of Retinal Detachment Using Region Of Interest (ROI) Based Color Analysis And Fuzzy C-Means Classification

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Abstract:

The retinal detachment is eye disease, it is described as a very critical condition in which all layers of retinal are pull away from its normal position. Due to retinal detachment visual disability or visual loss may cause, so the earlier diagnosis of RD is very important. This study aims related some method by using that we try to diagnosis of retinal detachment disease by using color of the retina selected by using Region of Interest (ROI), also diagnosis the stage of retinal detachment disease. In this research work we used the local dataset of Aravid_eye_care hospital from IEEE website which contain the retinal detachment fundas image. and preprocessing work done on MATLAB. In this study we work on the statistical parameters of the RD disease. i.e. color of retina. And also apply the Fuzzy C means Classification techniques of diagnosis of stage of retinal Detachment disease and calculate the accuracy algorithm.

Keywords: Retinal Detachment, Fuzzy C means, Region of Interest, Threshold, Statistical Parameters

Introduction

Eye is a nested structure of layers, with the retina being the focal and imperative layer that enables penetration of mild and coloration. In the human body the vital organ is built in a manner that an image formed is perceived when light travels through it. The Retina is the focal point of the eye.

In the world across billions of people have many visions impairment and some type of distance problem and concerning distance vision, 217 million people have very serious vision disability problem also 188.5 million people have mild vision disability problem. [1] with regard to 826 million people have close to vision damage [2] In the retinal detachment the retina gets detached from the choroid layer underneath also the retinal detachment is an ocular abnormalities. The detachment restricts the supply the nutrients to the retinal detachment can lead the blindness. The retinal detachment can be three types that depend on the layers of detached ocular globe: - retinal detachment can be further classified into
rhegmatogenous, tractional and exudative. The most common type of detachment types is Rhegmatogenous retinal detachment. And it courses due to the deteriorating and shortsightedness. When the contraction of scar tissues on retina's surface, causing retina to pull away the Tractional retinal detachment occurs and when the fluid , blood or tumor is present the behind the retina then Exudative retinal attachment occurs. [3,4] So the retinal detachment diagnosis in early stage is very challenging as RD often starts asymptomatically and progresses from a small size at the peripheral retina [5]. If the patient has a symptom such as flashes, curtain, and increasing floaters, many these patients attribute these changes to aging or problems with their glasses or contact lenses [6] Retinal detachments are by using the flowing symptoms: Increase number of flashes in front of eye, Increase number of floaters in front of eye, Loss of vision, Blurred vision, Reduced side (peripheral) vision, etc.

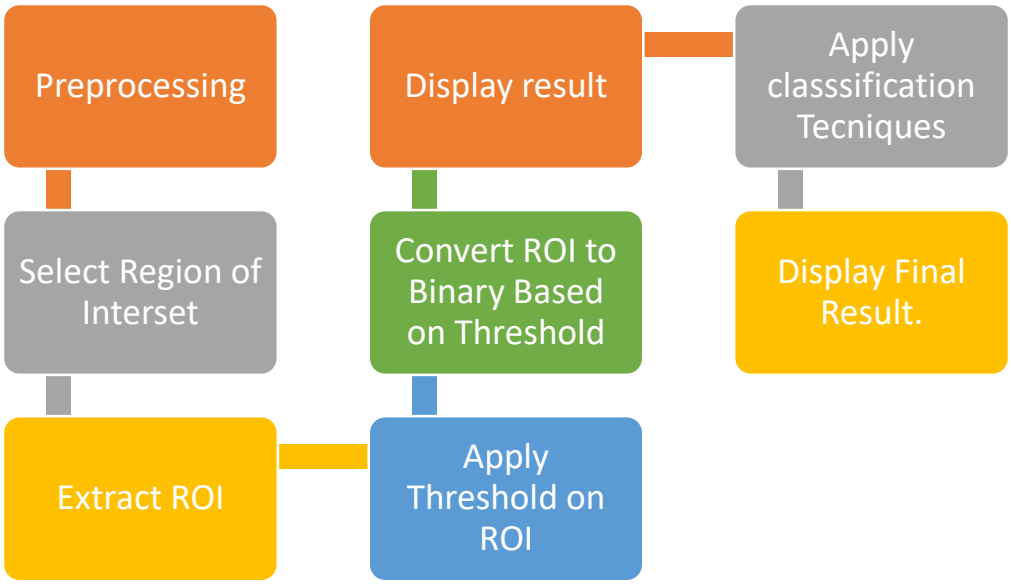
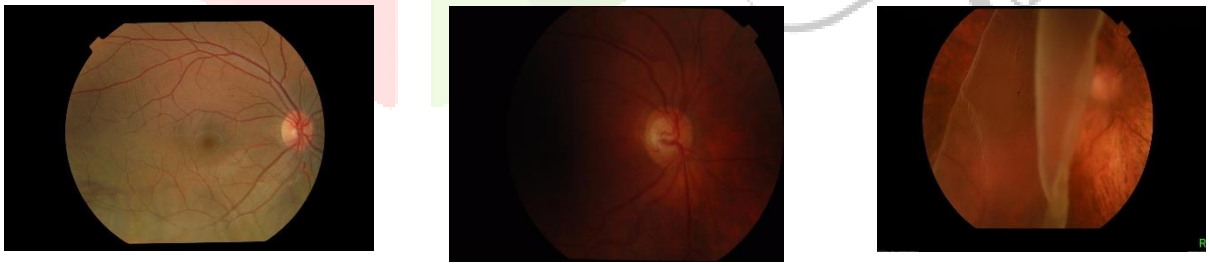


Fig 1: Flowchart of Proposed Methodology

In this Proposed methodology we used the local dataset of Aravid_eye_care hospital from IEEE website for diagnosis of retinal detachment position. In preprocessing steps, we remove the background noise of the image and also resize the image better visualization.

In this give preprocessing we convert the RGB image into gray color image for the selecting the Region of interest. as we discuss with ophthalmologist when the retinal detachment starts in retina then color of retina is changes

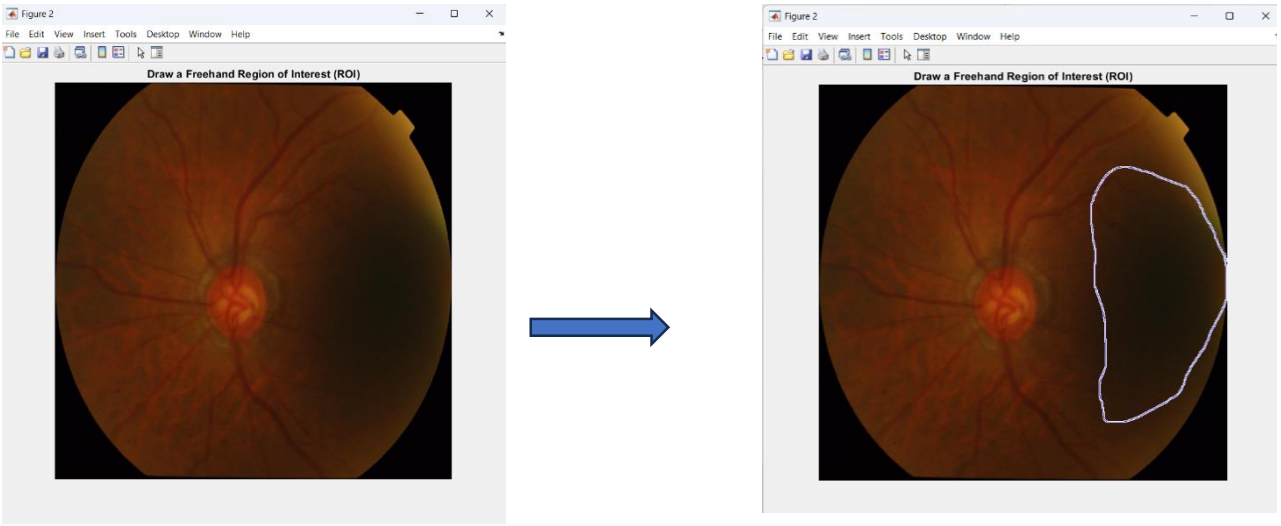
Following figure shows the Retina detachment.



Normal Retina Retinal Detachment Retinal Detachment

Fig 2: Difference between normal retina and retinal detachment

Pre-processing aims to produce an improvised image that reduces undesired distortions while simultaneously enhancing certain image qualities that are essential for characterization and additional processing. A high-quality fundus image should undergo the binarization preprocessing step in order to be closely examined. Every eye fundus picture undergoes preprocessing procedures to improve clarity and enhancement.



RGB Image **Choosing ROI from Image**

Fig 3: Choosing ROI from Image from Original Image

The area of an image that needs to be retrieved or where the tears or detachment has occurred is known as the region of interest (ROI). [8] In this study the area of region of Interest is consider as a color of retina. Therefore, region of Interest is Cropped for the for the further processing and analyzing the severity. Following Figure shows the utilizing the freehand tool to choose the ROI from the image in MATLAB. In this study for diagnosis of severity of retinal detachment the we convert the ROI cropped area into Binary format and calculate the threshold value of that Region for diagnosis of severity of disease.

Grayscale Image of freehand ROI **Threshold value of ROI**

Fig 4: Grayscale Image freehand ROI with its Threshold value.

After the calculating the threshold value of all images of Retinal we apply the classification techniques on that for diagnosis the severity of disease. In this study we compare two classification techniques for calculating the accurate result Fuzzy C means Clustering algorithm.

Classification techniques with Result

In this study we used Fuzzy C means Clustering algorithm, the Clustering is very important task in image Processing for identifying the pattern of data . The clustering challenge involves dividing a specific dataset into groups, ensuring that the data points within a group exhibit greater similarity to one another than to those in other groups. The divisions can establish a strict limit between sub-divisions; this is referred to as hard clustering. [9] In this study by using Fuzzy C means Clustering algorithm we plot Scattered diagram of ROI of statistical values. Which show the range of primary stage , moderated stage and Sever stage of RD disease. Fuzzy C-Means clustering aims to minimize the following objective function.

$$J_m = \sum_{i=1}^{N}\sum_{j=1}^{nC} U_{ij}^{m} \; ||x_i - C_j||^2$$

Where:

J_m= Objective function to minimize., N = Number of data points., C= Number of clusters, x_i= Data point i.

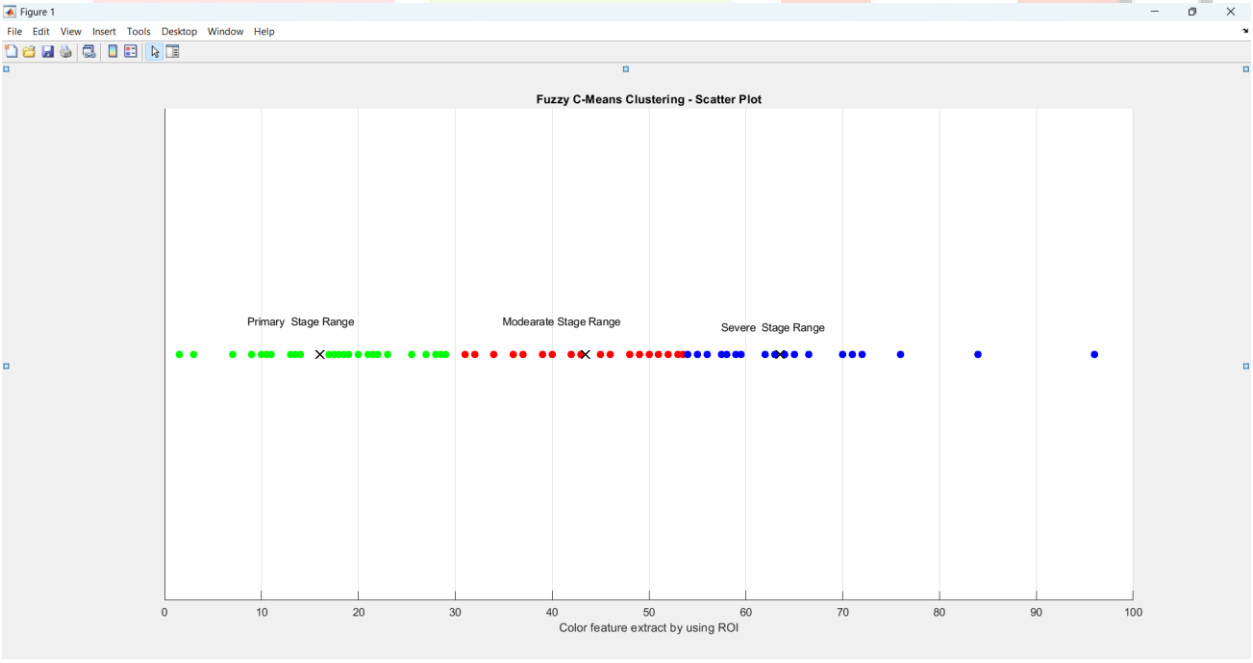


Fig .5. Classification using Fuzzy C Means Clustering Algorithm

In our experimental result we used local dataset of Aravid_eye_care hospital from IEEE website which contain the retinal detachment fundas image. which consist of 400 RD fundas images out of this we select 100 images for our proposed algorithm. By using Fuzzy C means classification techniques we classify the disease is in which stage. In above figure the green color shows the primary stage of disease. red color shows the range of moderate stage of RD, and blue color shows the range of sever stage of RD disease.

For evaluation purposes, we employ the usual performance measures of sensitivity (Se), specificity (Sp) and accuracy (Acc), defined as

$$S_e = \frac{TP}{TP+FN} \quad \text{[10]}$$

$$S_p = \frac{TN}{TN+FP} \quad \text{[11]}$$

And

$$A_{CC} = (\mathrm{TP} + \mathrm{TN})/(\mathrm{TP} + \mathrm{FN} + \mathrm{TN} + \mathrm{FP}) \quad \text{[12]}$$

Where the TP is true positive are correctly identified colors piles of Retina, FN is false Negative are color pixels incorrectly classified etc.

The final result Fuzzy c means clustering algorithm is show the accuracy of 94.23 %

The Final Summary of evaluates the performance of a classification model using Sensitivity (Se), Specificity (Sp), and Accuracy (Acc) for three different classes. Sensitivity, also known as recall, measures how well the model correctly identifies actual positive cases. For Class 1 and Class 3, the sensitivity is 1.00 (100%), meaning the model perfectly classified all instances of these classes without missing any. However, for Class 2, sensitivity is 0.860 (86%), indicating that while most instances were correctly identified, 6 samples were misclassified as Class 3. Specificity measures how well the model correctly identifies negative cases (i.e., how well it avoids false positives). The model achieved perfect specificity (1.00 or 100%) for Class 1 and Class 2, meaning it did not misclassify any non-Class 1 or non-Class 2 instances as those classes. However, for Class 3, specificity is 0.924 (92.4%), due to 6 misclassified Class 2 samples being predicted as Class 3. Overall accuracy is 94.23%, meaning the model correctly classified 98 out of 104 total test samples, demonstrating high reliability in predictions. While the model performs exceptionally well in distinguishing Class 1 and Class 3, there is a slight classification error between Class 2 and Class 3, indicating room for improvement in feature differentiation between these classes.

Conclusion:

In this paper we have diagnosis the Retinal detachment disease stage. In this research work we select the parameter for the diagnosis of RD disease is color. We also calculate the statistical values of that by using Region of Interest. we also verify these statistical values from ophthalmologist for apply the different classification techniques. in this research we apply Fuzzy c means classification techniques on that and calculate the Sensitivity (Se), Specificity (Sp), and Accuracy (Acc) for the class. In future work we camper this classification techniques to another classification techniques for the best result.

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