

# DETECTION OF CATARACT BY STATISTICAL FEATURES AND CLASSIFICATION

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**Abstract-** *Cataract is the major cause of blindness in the world and the most prevalent ocular disease. Increased risk of cataract development is associated with UV exposure, steroid use, diabetes, and smoking. This process cannot be reversed, but a healthy lifestyle may slow the progression. Earlier diagnosis of cataract will prevent vision loss. In this paper a new method has been proposed to diagnosis of cataract using statistical features and its severity has been classified using K-means and ANFIS classifier.*

**Keywords:** Fundus image, AHE, Thresholding, K-means, ANFIS

## 1. Introduction

Image processing and analysis is a vast area of application, one such field is the medicine. From olden days ,humans get affected by the variety of diseases especially in the case of delicate organs like eyes. One such eye disease is called cataract which has no initial symptoms leads to the blindness. Cataract means clouding of lens, starts to decreasing the vision which prevents entering the light into the retina shown in figure 1.1. It is the first and foremost diseases causing blindness. It is different from the color blindness. The main causes are sugar, blood pressure, aging factors, consumption of alcohol, exposure to UV radiation etc., There are 3 types namely nuclear, cortical and posterior. The most common type is nuclear cataract which forms in the centre of lens and the nucleus become pale or yellow color. When eye get injured by some infection also the occurrence of cataract is possible called as Traumatic cataract. A cortical cataract is another type occurs in cortex of lens , which surrounds the central nucleus.



**Figure 1.1** Cataract Diseases

Neha Naik, Namrata Deshmukh[1] Cataract is a clouding of the lens of the eye and occurs frequently in older age groups. In proposed system, diagnosis will be obtained using image processing and mining techniques on fundus image. Feature extraction using DCT. K-NN classification algorithm will be used to classify the image in a specific class.

Sreejaya, Merlin K Mathew[2] Cataract can affect single or both eyes. The symptoms may include cloudy or blurred vision, colors that may not appear as bright as they once did, glare, poor night vision. A nuclear cataract forms deep in the central zone (nucleus) of the lens in eyes which is the most common type of cataract. This paper gathered and analyzed various techniques and concepts for cataract detection.

Yew Chung Chow, Xinting Gao[3] Cataract diagnosis in human grading is subjective and time-consuming . Automatic detection based on texture and intensity analysis is proposed to address the problems of existing methods and improve the performance from three aspects, namely ROI detection, lens mask generation and opacity detection. In the detection method, image clipping and texture analysis are applied to overcome the over-detection problem for clear lens images.

Jagadish Nayak[4] Cataract is an eye disorder, will lead to reduced eyesight. If cataract is not treated in proper time, then it will lead to blindness. The features of the optical eye image such as Big Ring Area (BRA), Small Ring Area (SRA), Edge Pixel Count (EPC) and Object Perimeter are extracted in proposed method. These features are then used in automatic classifier namely SVM.

## 2. Proposed Method

The entire process to detect the earlier diagnosis of cataract which are arranged as follows: pre processing method namely Adaptive Histogram Equalization is used in diagnosis process. Thresholding technique is used for feature extraction. The obtained features are given for automatic classifier namely K-means and ANFIS and classified as normal, mild and severe. The block diagram of the proposed scheme is shown in fig1.2.

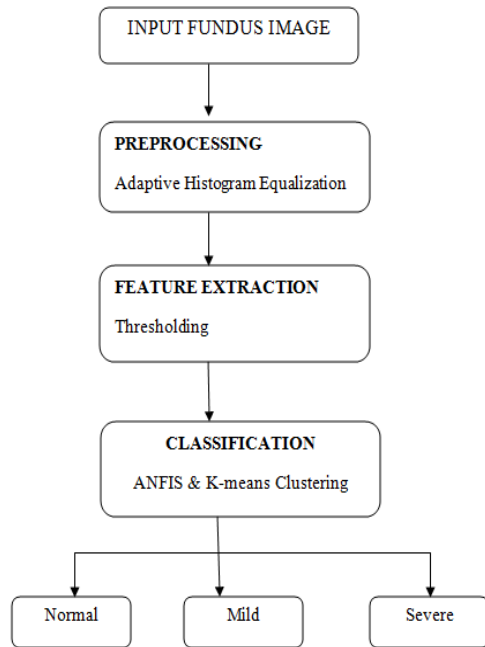


Figure 2.1 Block Diagram of Proposed Work

**A. DIAGNOSIS OF CATARACT**

The statistical features like mean, entropy, standard Deviation, area, uniformity has been calculated by thresholding technique for cataract diagnosis.

**• Pre-processing**

Preprocessing is performed to obtain noise free and enhanced image, which can be used to detect features. Preprocessing of poor quality images can ensure adequate level of success in the automated abnormality detection. The color images are converted to the gray scale images, because the retinal abnormalities have better visualization in the gray scale when compared to others. Then the preprocessing techniques are applied to the gray scale images which performs image enhancement.

Here, Adaptive Histogram Equalization(AHE) has been proposed. It is a contrast enhancement technique to avoid amplifying the noise which is present in image. AHE is different from histogram equalization .The pre-processed output has been given for feature extraction.

**• Feature Extraction**

The preprocessed output has been given as input for feature extraction . Here, Thresholding technique is used for statistical feature extraction. The statistical features like mean, entropy, standard deviation, intensity, area, uniformity has been obtained. The threshold value for mean,

entropy ,uniformity ,standard deviation, area and intensity. For all these features, above the threshold value there will be a detected as possibility and occurrence of cataract.

**3. Classification**

Classification involves the data which is used to assign the corresponding levels with respect to groups with homogenous characteristics with the aim of discriminating multiple objects from each other within the image

**• K-means clustering**

K-means is the simplest unsupervised learning algorithm which solves the clustering problem. It is a vector quantization method which aims to partition ‘n’ observation into K-clusters. The flowchart of K-means is shown in figure 3.1. It produce an competitive results and hence used in image segmentation.

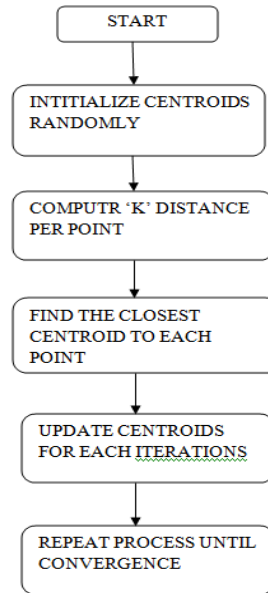


Figure 3.1 Flow chart of K-means clustering

**• ANFIS**

Adaptive Neural Fuzzy Interface System is an adaptive network. An adaptive network is a network of nodes and directional links. This network is called adaptive because some or all of the nodes have parameters which affect the output of node. The ANFIS architecture is shown in figure 3.2. The circular nodes represent nodes that are fixed whereas the square nodes are nodes that have parameters to be learnt.

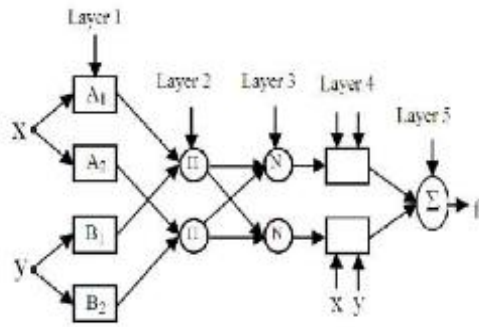


Figure 3.2 ANFIS architecture

For the training of a network, there is a forward pass and a backward pass. The forward pass propagates the input vector through the network layer by layer. In the backward pass, the error is sent back through the network in a similar manner to back propagation.

4. Experimental Results

A. Results of Pre processing

The experimental results of pre processing by applying AHE as shown in figure 4.1 and 4.2



(a) Original image (b) AHE image

Figure 4.1 and 4.2 original and pre processed output

B. Statistical Features

The statistical features are obtained for normal and affected images by applying thresholding from the pre processed output as tabulated in table 4.1 and 4.2 as shown below. The standard deviation is similar for both healthy and affected images, so the values of SD obtained need not be considered for classification process.

Table 4.1 Statistical Features for Healthy Images

MEAN	ENTROPY	STANDARD DEVIATION	AREA	INTENSITY	UNIFORMITY
42.9	4.59	49.13	76854	2.6	0.0121
40.45	4.52	46.78	72468	2.8	0.0489
34.94	4.75	37.17	35221	2.65	0.1762
37.85	4.12	38.04	67809	4.7	0.0564
45.62	4.8	46.74	45973	2.54	0.0467
36.44	4.79	38.82	36723	2.03	0.1456
36.44	4.76	38.33	36726	3.01	0.1762
41.55	4.92	45.99	41872	2.86	0.0234
38.57	4.87	41.73	38873	3.29	0.0345
40.94	4.91	44.61	41262	4.2	0.1456
37.65	4.79	40.42	37938	3.62	0.0567

Table 4.2 Statistical features for Affected Images

MEAN	ENTROPY	STANDARD DEVIATION	AREA	INTENSITY	UNIFORMITY
91.38	7.22	37.72	21931	10.5	0.3567
90.12	7.14	36.21	21627	12	0.5678
91.94	7.14	37.35	22064	8.7	0.3211
85.16	7.1	36.03	20438	7.8	0.3
94.81	7.09	37.28	22753	9.4	0.52
85.22	7.21	38.4	20453	6.7	0.621
77.58	6.97	32.68	18619	5.6	0.872
90.45	7.22	50.25	21707	9.02	0.267

C. Classification results

1) K-means Clustering

The obtained statistical feature is given as input for the ANFIS and K-means algorithm. The obtained output for K-means algorithm is shown in figure 4.3. The color violet - normal, yellow- mild and blue-Severe.

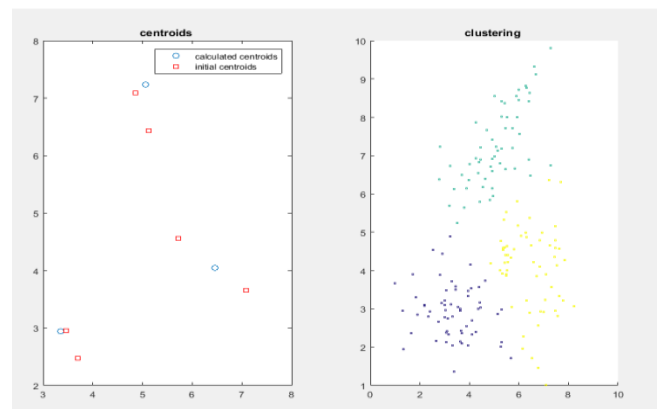


Figure 4.3 Centroid calculation and clustering output

**Table 4.3** Number of training and testing data for K-means

STAGES	No. of training data	No. of testing data
Normal	20	19
Mild	15	10
Severe	15	12

From the obtained result the sensitivity and specificity are calculated by the formula,

$$\text{Sensitivity} = TP / (TP + FN)$$

$$\text{Specificity} = TN / (TN + FP)$$

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

Where, TP-True Positive

TN-True Negative

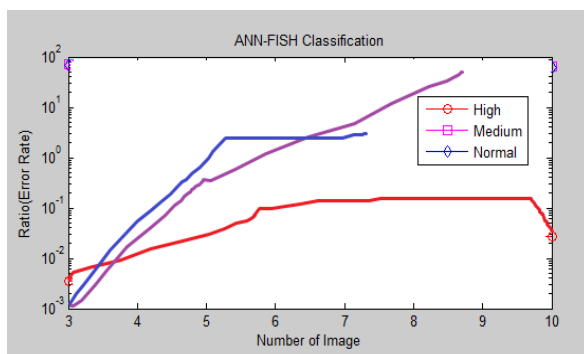
FP-False Positive

FN-False Negative

The obtained sensitivity and specificity are Accuracy =98.57%, Sensitivity = 92% and Specificity =95.33%.

## 2) ANFIS Classification

The ANFIS classification output is shown in figure 4.4. The output is classified as normal, mild and severe stages.



**Figure 4.4** ANFIS Classification output

The number of training and testing data are tabulated in table 4.4

**Table 4.4** Number of training and testing data for ANFIS

STAGES	No. of training data	No. of testing data
Normal	20	15
Mild	15	10
Severe	15	12

From the table the obtained sensitivity and specificity are shown below: Accuracy=97.77% Sensitivity=85.7% Specificity=93%.

## 5. Conclusion

This work developed a earlier diagnosis for cataract detection. The fundus image was enhanced by Adaptive Histogram Equalization. The statistical features as mean, entropy, standard deviation, area, uniformity, intensity were extracted by thresholding technique. The extracted features were given as input for K-means and ANFIS classification. From the experimental results of the proposed system, accuracy, sensitivity and specificity for K-means clustering produced good results. The average accuracy of the tested results for the K-means and ANFIS are 98.57 and 97.77 respectively. Also, the average sensitivity, specificity, for the K-means and ANFIS classifier tested images are 92,95.33,85.7 and 93 respectively The obtained sensitivity, specificity and accuracy were better for K-means clustering algorithm. In future various algorithms has been used to detect the earlier cataract detection

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