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Revelation of Glaucoma Adopting Hybrid Structural and Textural Features

V. R. Balaji and J. Sathiya Priya

Department of Electronics and Communication Engineering, Sri Krishna College of Engineering and Technology, Coimbatore – 641008, Tamil Nadu, India;
balajivr@skcet.ac.in, sathiya.vlsi@gmail.com

Abstract

Objectives: To make the automatic detection of Glaucoma at early stage of the disease. **Methods/Statistical Analysis**: Fundoscopy is one of the medical specialty techniques to understand the inner structure of the membrane. In this study, we tend to project the combination of structural and textural characteristics of a fundus image to solidify the eye disease diagnosis. **Findings**: The planned technique introduces an extraction of structural and textural features by the Naive Bayes algorithm and it is classified using the decision tree algorithm to detect the glaucoma cases. Naive Bayes can be implemented fast and ease in the less dataset. The planned technique introduces a category of perpetrators in the machine-controlled diagnosis in the event of any conflict in the determination of structural features. **Application/Improvements:** The estimate of the proposed algorithm is carried out using the local database of 100 patients with fundus images. It calculates the instance value to identify the glaucoma level. The proposed system gives exceptional results with better accuracy.

Keywords: Decision Tree, Fundus Images, Naive Bayes, PCA

1. Introduction

Worldwide, glaucoma is one of the diseases associated with visual impairment. It accounts for 15% of the population. Around 5.2 million of the total population got affected by glaucoma disease[1]. The ailment is related to the breaking down of the eye's waste framework which makes a high intra-visual weight which influences the segments of the optic nerve. It can result in perpetual visual impairment whenever left untreated[1]. Since the ailment is irreversible, a screening framework is accordingly required to recognize the infection in its initial stage.

2. Literature Survey

The detection of glaucoma can be found by many methodologies using automated glaucoma systems. In[2] proposed an algorithm for OD Detection. It depends on structured learning. They utilized Circular Hough Transform to near the limit of OD. Thresholding is used to obtain OD edges. The proposed algorithms are supervised methods. They achieved better results. In[1] proposed glaucoma detection by calculating Cup to Disk Ratio value. It extracted the optic disk and cup to analyze with CCDR value. They provided the fusion of CDR, intensity and textural features by classification.

*Author for correspondence

SVM was used to classify the training set. In[3] Glaucoma can be detected by exaggerated through Adaptive Gamma Function with Weighted Distributed Function.

They used the Gabor filter to remove the blood vessels and the features are extracted using WBCT. It used for the improvisation of stability. Then it moved to the Naive Bayes classifier to detect glaucoma and normal images. In[4] proposed the technique that ROI detected and in preprocessing, morphological operations were carried out. In the next step, the segmentation was done by K-means clustering. Canny edge detection was applied to found the boundaries of optic disk and cup. The proposed method gave accuracy results. In[5] proposed the spatial and spectral features based on the classification of glaucoma. This paper comprises of three sections. They are the proposed method, Experimental Results, and Conclusion.

3. Proposed System

The proposed method is shown in Figure 1. It consists of Image conversion, Image enhancement followed by classification based on hybrid structural and hybrid textural features. The features are processed by the PCA method and features are extracted by the Naive Bayes Algorithm. Then, at last, the images are classified by the Decision Tree Algorithm.

3.1 Image Conversion

Every pixel is indicated by three qualities red, blue and green. The original image is shown Figure 2. It doesn't assist us with identifying vital edges. Along these lines, image conversion[6] is done in the way towards changing over RGB to dark. Grayscale pictures are progressively reasonable for specific applications. When the picture is in RGB design and our application needs a grayscale image then we can utilize the rgb2gray transformation and it is shown in Figure 3. When we are working with shading picture, we will not utilize RGB 2 gray transformation comparably if the image is in grayscale.

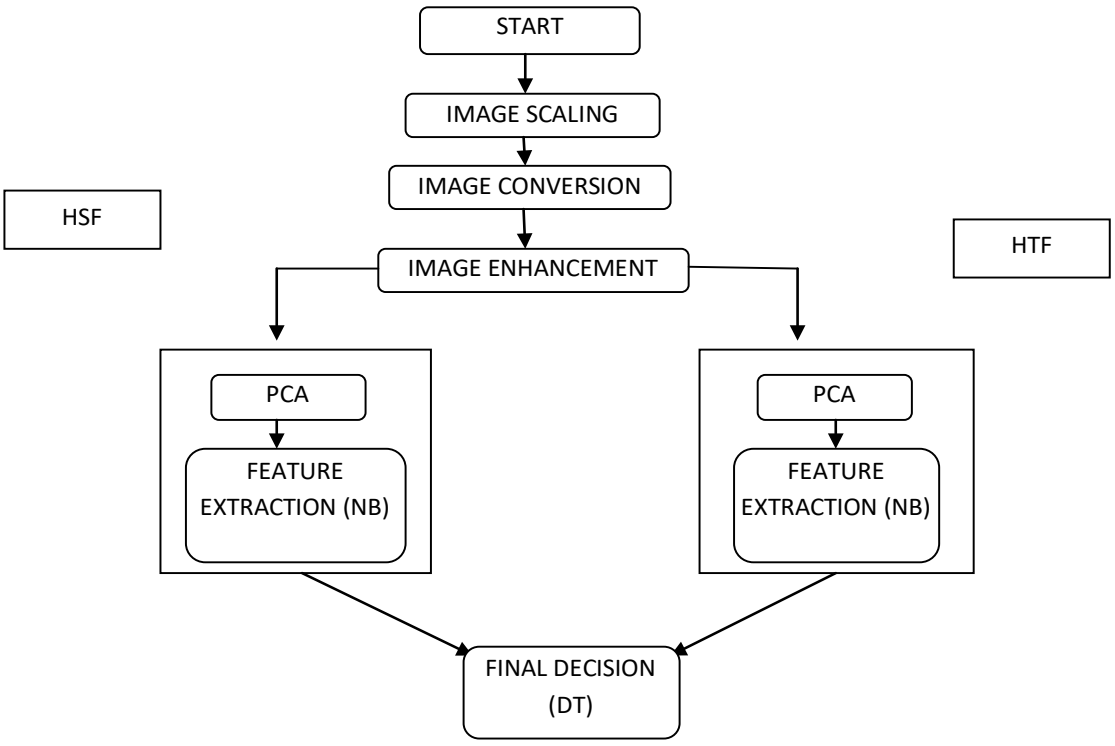

Figure 1. Proposed method.

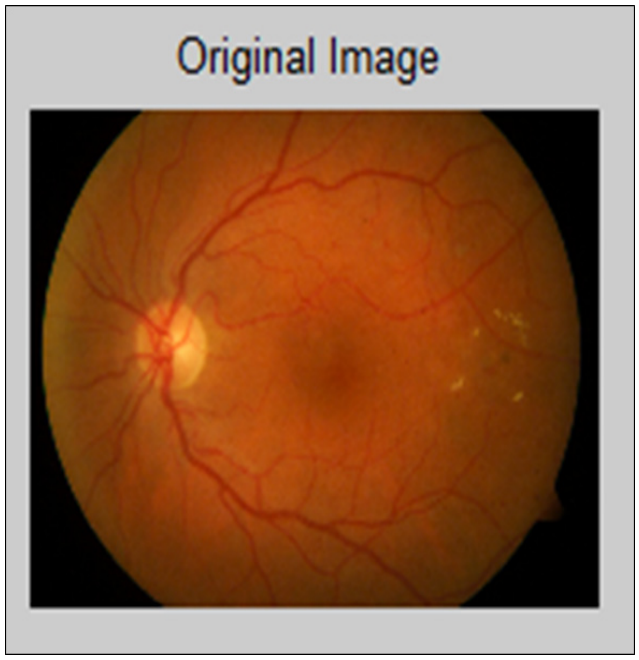

Figure 2. Original image.

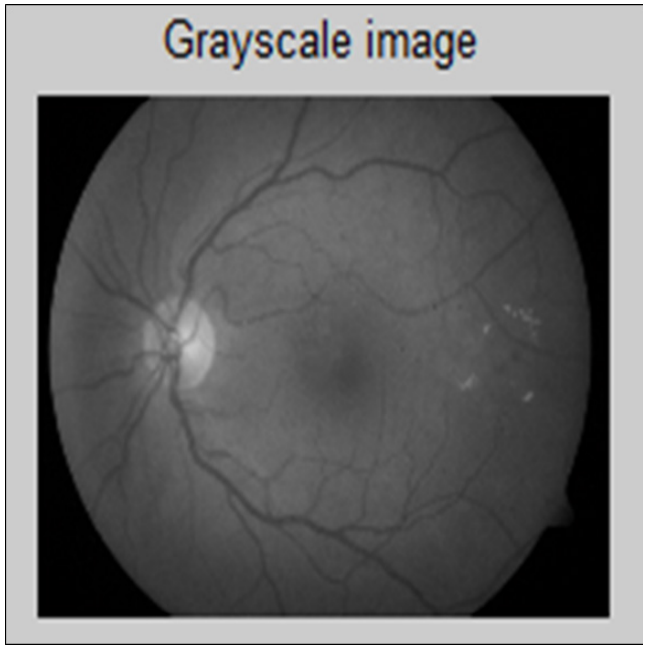

Figure 3. Grayscale Image.

3.2 Image Enhancement

One of the image processing techniques to enhance contrast is image enhancement. Contrast may be an important think about the subjective analysis[7] of image quality. The contrast of an image is in a specific range. The difference in color and brightness leads to contrast to make an image lighter or brighter. It is a preprocessing method and the enhanced image is shown in Figure 4.

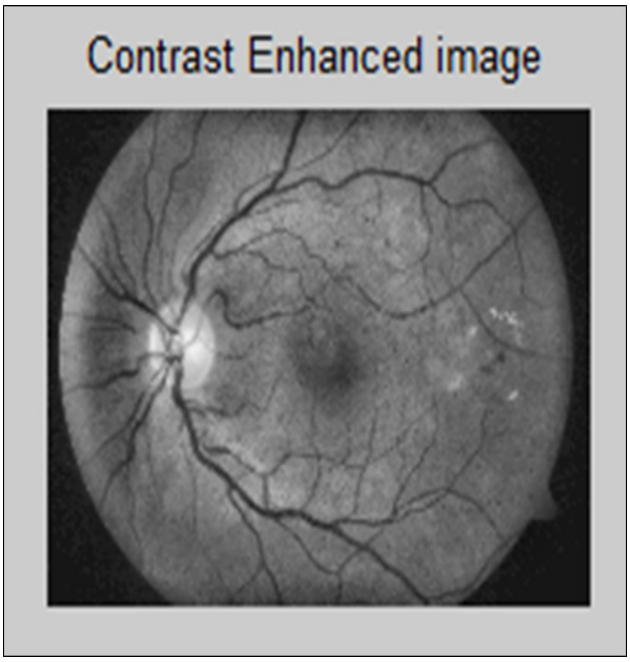

Figure 4. Enhanced image.

3.3 Histogram Equalization

The histogram represents the graphical representation of gray values. When all in done, a histogram is the estimation of the likelihood conveyance[8] of a specific kind of information. For this situation, there are 256 gray levels and the images just have values around 50–100. Consequently, this picture has a low differentiation. The histogram in image enhancement produces the graphical representation of pixels in eye as shown in Figure 5.

3.4 Structural Features

Principal Component Analysis:

Important part examination in flag handling can be portrayed as a change of a given arrangement of n input

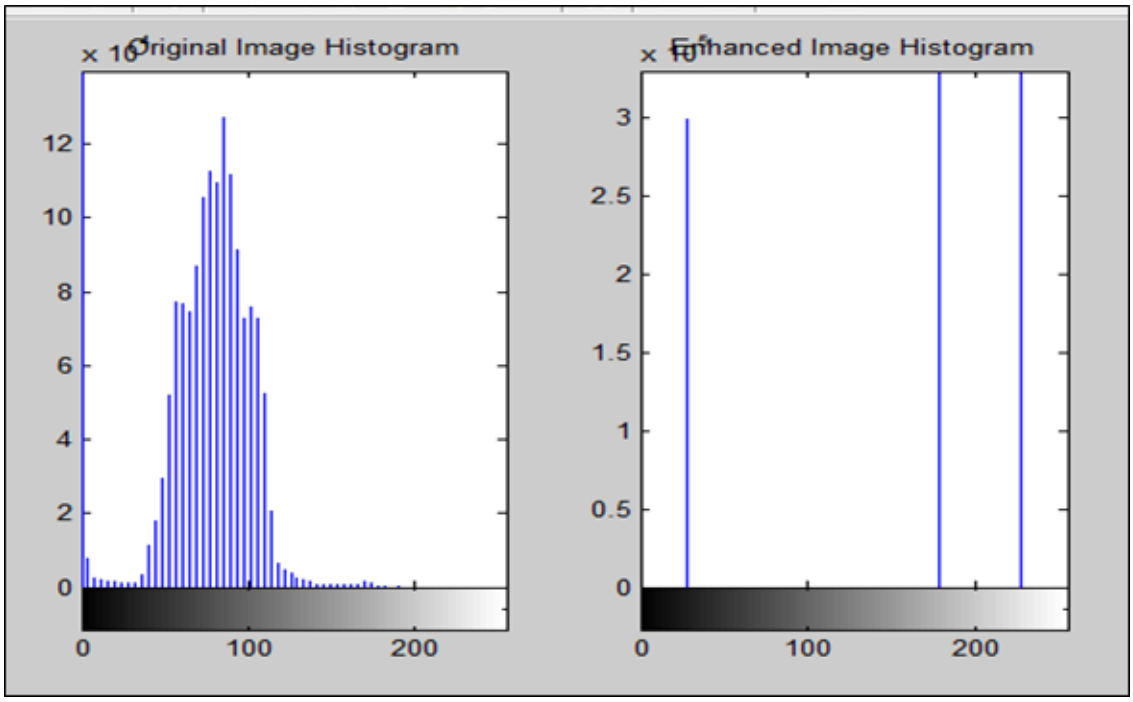

Figure 5. Histogram Equalization.

vectors (factors) with a similar length K shaped in the n-dimensional vector[9] x = [x1, x2, ...xn]T into a vector y as per:

$$y = A\,(x - mx) \quad (1)$$

A vector x of info factors is n-dimensional clearly the measure of Cx is n x n. The components Cx(i, I) lying in its fundamental inclining are the fluctuations

$$Cx(i, I) = E\{(xi - mi)2\} \quad (2)$$

of x and alternate qualities Cx(i, j) decide the covariance between info factors xi, xj.

$$Cx(i,j) = E\{(xi - mi)(xj - mj)\} \quad (3)$$

between information factors xi, xj . The columns of An in Eq. (1) are orthonormal so the reversal of PCA is conceivable as per connection

$$x = ATy + mx \quad (4)$$

Figure 6. PCA images.

Then the PCA1, PCA2, PCA3 are calculated. Figure 6 provides the images after Pre processing is done.

3.5 Feature Extraction

By finding the PCA analysis, then the features are extracted by the Naive Bayes Algorithm. In these, the images are calculated by the algorithm as found by the optic disk and thresholded image[10]. Figure 7-8 provides the images after Pre processing is done.. In these structural features,

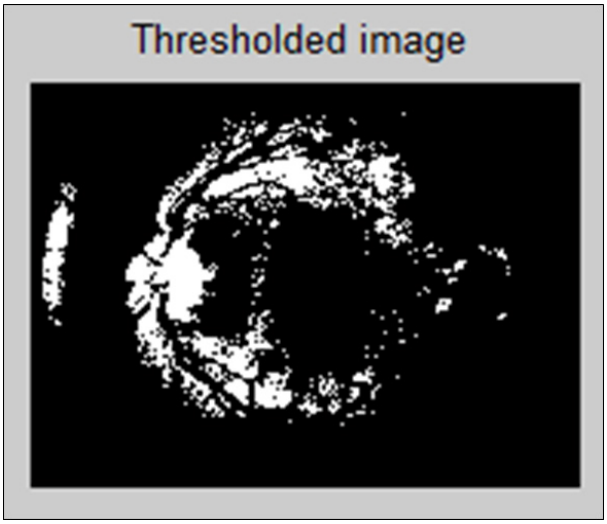

Figure 7. Threshold image.

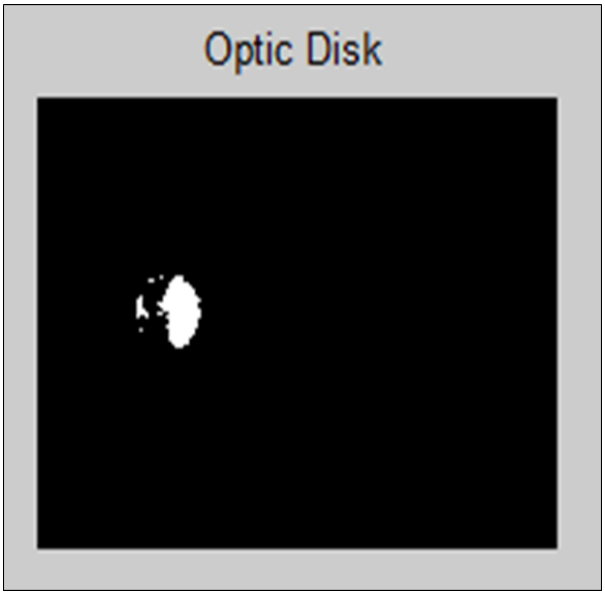

Figure 8. Optic disk.

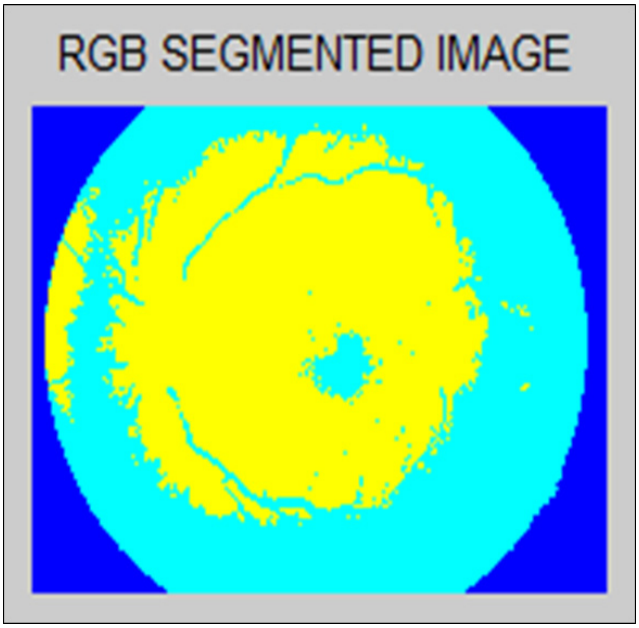

Figure 9. RGB.

the red, green and blue color channels[11] are extracted by Naive Bayes algorithm and morphologically opening the images as shown in Figure 9.

3.6 Textural Features

The textural features are also extracted by the Naive Bayes

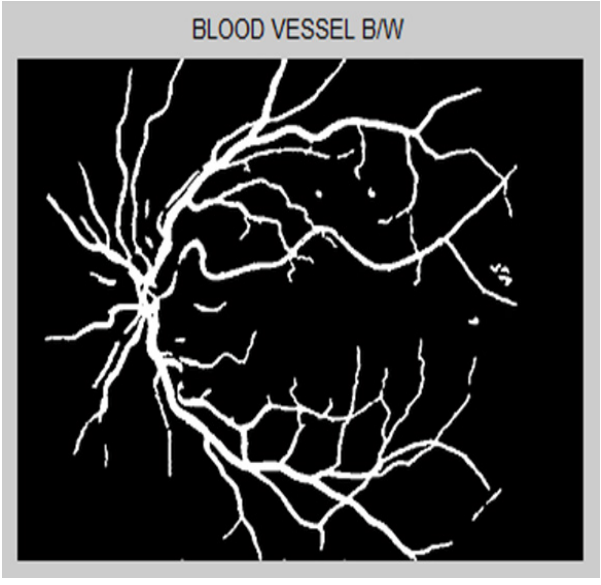

Figure 10. Blood vessel bandwidth.

Figure 11. Blood vessel trace.

algorithm[12]. The textural feature consists of blood vessel bandwidth and blood vessel trace as shown in Figure 10 and 11 respectively they are predicted in three ways.

Thus the structural and textural features are calculated[13] and the decision tree algorithm is used to classify the glaucoma cases.

4. Experimental Results

By applying the Decision tree, the classifiers perform the operations on the features such as hybrid structural and textural features. The instance value was calculated and it represents in graphs as shown in Figure 12 and Image analysis data is also shown in Figure 13. Mean, entropy

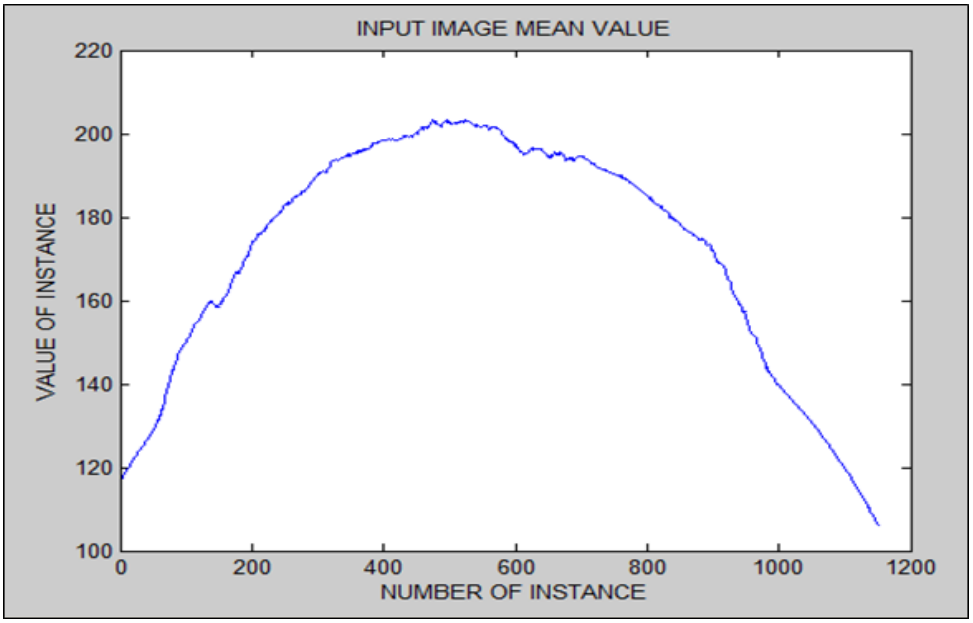

Figure 12. Instance value.

Table 1. Image level description

Database	Healthy	Glaucoma
DRIVE	34	6
DRIVES	95	15

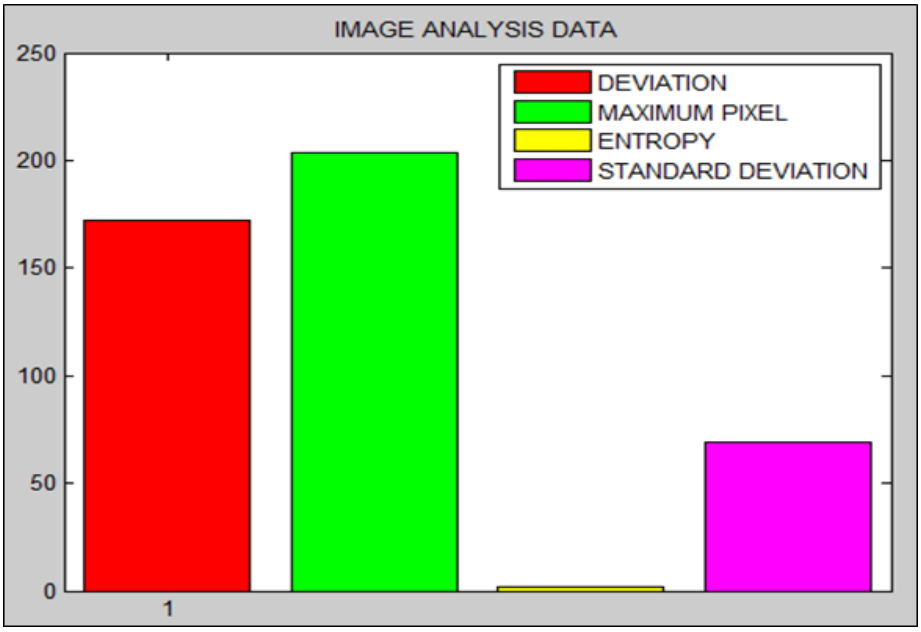

Figure 13. Image analysis data.

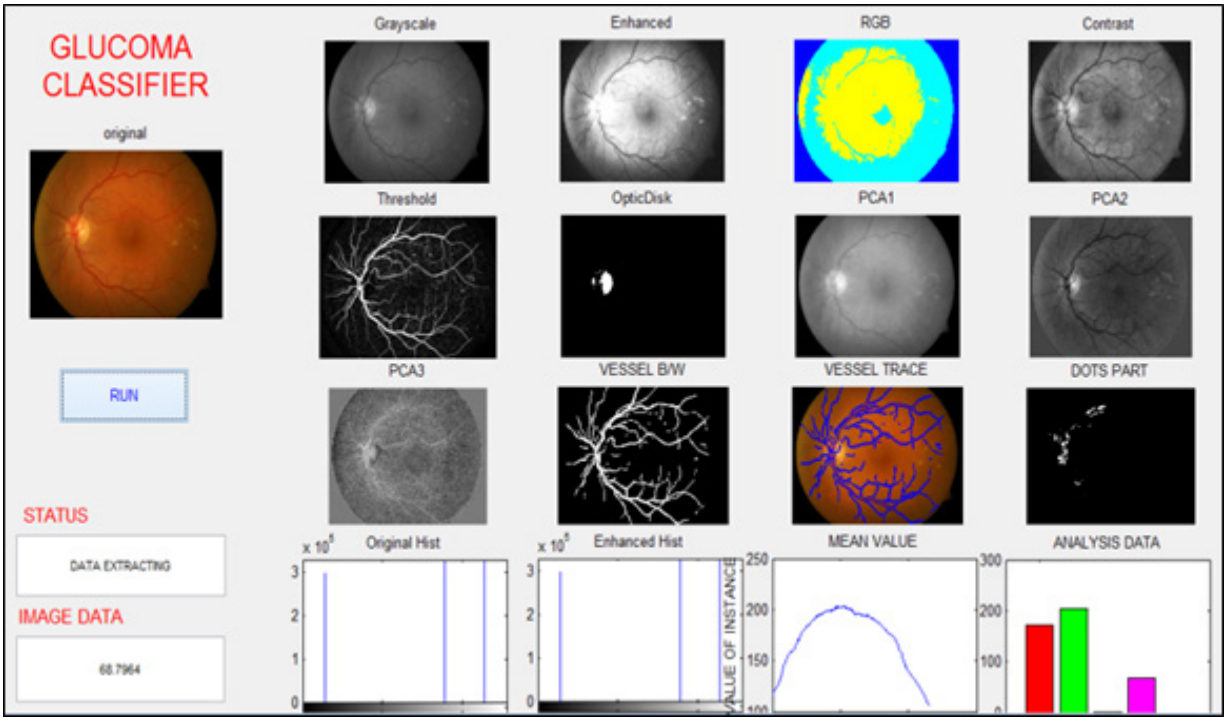

Figure 14. GUI.

and standard deviation are calculated and these processes are implemented in GUI in a common window shown in Figure 14 to perform easily. Table 1 shows the Image level description of the image.

Most databases of normal and glaucoma images are trained and used in this classification and the Table 1 provides the inference of how the eyes are getting affected by glaucoma.

5. Conclusion

In this study, a novel method is provided for detecting glaucoma disease. The proposed system extracted hybrid structural and textural features through the optic disk. A Decision tree classifier is used to classify glaucoma. The testing of the proposed system has conducted using publicly available datasets. Images from various sources are utilized for appropriate testing and assessment of the proposed work.

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