Abstract: Analyzing the retinal images is very helpful to diagnose the human eye diseases like Retinopathy and to interpret various problems in medical field. Retinal images quality is usually contaminated by noise and other illumination condition. In order to enhance the quality of retinal images focus should be made on contrast enhancement and noise removal. The best known technique for effective contrast enhancement is Unsharp masking technique. In this paper we will use Genetic Algorithm with multi-objective function for efficient retinal image enhancement. First the random chromosomes will be initialized using heuristic approaches and then perform adaptive crossover and mutation. Finally results are analyzed using performance measures.

Keywords—Contrast Enhancement, Genetic Algorithm, Retinal Imaging, Unsharp Masking.

I. INTRODUCTION

Contrast is the difference in optical properties that makes an object (or its representation in an image) apparent from other objects and the background. In other words we can say that it is the difference between the darker and the lighter pixel of the image, if it is high the image will have high contrast otherwise low contrast. Contrast Enhancement techniques play important role in field of retinal image enhancement because it helps in diagnose of human eye diseases by enhancing the quality and removing the noise from retinal images.

Generally the major objective of image enhancement is to process an image so that processed image is more suitable than the original image for a particular application. Image enhancement techniques are divided into different classes as mentioned below.

- **Histogram Based** transformations are one of the most basic techniques for the enhancement of gray level images. The various histogram based techniques used for contrast enhancement are Histogram equalization, Bi- Histogram Equalization, Adaptive Histogram equalization.

  - **Histogram Equalization**: It is one of the most popular methods used for image enhancement. The intensities of image are adjusted to enhance the contrast of an image.

  - **Bi-Histogram Equalization**: this method is used to overcome the drawback of histogram equalization. It decomposes the input image into two sub images and then applies histogram equalization to each sub image and then produces the output image whose value of brightness is equal to mean of gray levels

- **Masking Based** transformations for contrast enhancement are derived approach in which formulated mask is added to base image in order to enhance base image. Masking based approaches are used to sharpen or smoothening of an image. Unsharp masking is classical approach for sharpening of an image.

  - **Unsharp Masking** is a derived contrast enhancement technique which generates the sharpened image by subtracting the blurred image from original image. It is one of the best known masking technique for retinal images.

Sharp image \(s(x,y) = \text{orig image } f(x,y) - \text{blur image } f'(x,y)\).

Genetic Algorithm (GA) is an optimization technique given by John Holland in 1978. It randomly generates the set of

Figure 1: Image enhancement techniques
possible solution by using the operators named as reproduction, crossover and mutation. The genetic algorithm technique has swift development in image processing application. Hemanth D.J., Anitha, J. [4] comes up with modified crossover technique in GA for performance enhancement of retinal images. Wang [17] proposed the multi-objective watermarking genetic algorithm for enhancement of retinal images. In this paper the green plane retinal image is enhanced using genetic algorithm with multi-objective function. The Simple Genetic Algorithm (SGA) uses single objective function therefore it can enhance the brightness of images but does not guarantee the overall performance of an image. SGA is rich with crossover and mutation operator but it is not effective in initialization of random chromosomes. The proposed technique initializes the random chromosome by using heuristic approaches.

II. LITERATURE SURVEY

Daniel E., Anitha J. [11] proposed the green plane masking using enhanced genetic algorithm for contrast enhancement. The green plane is used because it is the most informative plane of color images. The uses enhanced genetic algorithm which enhances only the brightness of retinal images. They uses AMBE performance measurement parameter to analyze the results.

Paranjape S.V., Ghosh S et al. [1] comes up with fuzzy contrast enhancement technique for retinal images. The analysis of retinal images for diagnosing the diseases is important in the field of medical science. They uses rule base fuzzy interface system in addition with partial histogram for contrast enhancement of retinal images.

Datta N.S., Saha, P. et al. [2] explains the concept of retinal image enhancement in diabetic screening system. The method used protect the mean brightness and overall image quality. The parameter used for performance measurement is AAMBE.

Jintasuttisak T., Intajag S. [3] gives the adaptive histogram equalization method for enhancement of color retinal images. They uses NHSI color model for maintaining the color information and uses Rayleigh transformation for preserving the brightness of retinal images.

Hemanth D.J., Anitha, J. [4] comes up with modified crossover technique in GA for performance enhancement of retinal images. GA is widely used optimization technique for performance enhancement but has drawback of randomness which degrades the performance so authors uses modified GA.

Jadiya S., Goyal A., Jain V. [5] explains the contrast enhancement and brightness preservation through independent histogram equalization. Independent HE enhances the hidden details and also improves the contrast of original image. the GA determines the threshold value for portioning of histogram.

Osareh A.; Shadgar B.; Markham R [6] presents the method for automated identification of exudates in retinopathy images. They segment the color retinal images using fuzzy logic. GA ranks the features and identify the subset to give the best result.

Langroudi, M.N.; Sadjadi, H [7] explains the automated method to detect retinopathy. The authors detect the five different types of lesions using the proposed algorithm.

Sumathy, B.; Poornachandra, S [8] uses the new adaptive histogram approach to extract the features of retinal images. The optical disc is difficult to analyze due to its brightness but the method used by authors gives the suitable results.

Chen Hee Ooi; Isa, N.A.M [9] uses two methods for adaptive contrast enhancement and brightness preservation. They first divide the histogram on the basis of median and then uses the advancement of bi-histogram equalization i.e. BHEPL which outperform the conventional method by producing clearer enhanced images.

Gautam, C.; Tiwari, N [10] comes up with range limited Bi-histogram equalization in order to enhance the color images. The proposed method with adaptive gamma correction produces the best results for low contrast images. This method efficiently enhances the image contrast.

III. GAPS IN LITERATURE

The survey has shown that most of image enhancement and simple genetic algorithm techniques have certain limitations.

Following are main limitations in earlier work:

1. Genetic algorithm is a single objective in nature therefore it can enhance the brightness of images but does not guarantee the overall performance of an image.
2. The genetic algorithm is rich with crossover and mutation operator but it is not effective in initialization of random chromosomes.
3. Static scaling selection techniques used in genetic algorithm produces over sharpened or under sharpened retinal images.

IV. PROBLEM FORMULATION

Retinal images play a vital role in early detection and management of diseases that can affect both our eye and overall health. These images are usually contaminated by noise and other illumination conditions. Recently much work is done in the field of retinal image enhancement. Many techniques have been proposed so far for enhancing retinal images. It has been found that most of the existing techniques like simple genetic algorithm which uses of randomly initializing the chromosomes single objective function to enhance the retinal images only enhances the brightness of an image but does not guarantee the overall performance of an image. To overcome this problem we have introduced multi-objective function for efficient
retinal image enhancement. We will also use heuristic approaches for initialization of chromosomes instead.

Objectives

1. To propose a new genetic algorithm approach for contrast enhancement of retinal images using multi-objective function.
2. To enhance the initialization technique for initializing the chromosomes in order to attain better results.
3. To measure the performance of proposed method using following parameters
   a. PSNR
   b. AMBE
   c. RMSE

- **Peak signal to noise ratio** (PSNR) is a parameter used to measure the quality between original image and enhanced image.
- **Absolute mean brightness error** (AMBE) is a parameter used to measure the accuracy of technique used to enhance the image.
- **Root mean square error** (RMSE) is also a quality measure parameter.

V. METHODOLOGY

The technique used for enhancement of green plane retinal images is explained below. The green plane retinal image is filtered using median filter then genetic algorithm with multi-objective function based scale selection is done. It can dynamically select the scale value for green plane mask and at last masked image is added to green plane retinal image to produce enhanced retinal image.

Figure 2: Block diagram of proposed technique

The genetic algorithm with multi-objective function is used for scale optimization in our application of contrast enhancement. In our enhanced genetic algorithm approach we can dynamically perform the enhancement. The various steps involved in genetic algorithm with multi objective function are as follow:

- **STEP 1**: take the input green scale retinal image.
- **STEP 2**: Initialize the chromosome using heuristic approaches.
- **STEP 3**: Calculate the fitness value using multi-objective function.
- **STEP 4**: Apply one point adaptive crossover.
- **STEP 5**: Apply adaptive flipping mutation.
- **STEP 6**: The enhanced image is generated.
- **STEP 7**: Analyze the performance of genetic algorithm with multi-objective function and return the metrics.

Figure 3: Flow chart of proposed genetic algorithm

VI. CONCLUSION

Contrast enhancement of retinal images with single objective genetic algorithm produces the enhanced image but it only enhances the brightness of the retinal images not upgrade the overall performance of retinal image. A proposed genetic algorithm with multi objective function not only enhances the overall image but also initialize the chromosomes using heuristic approaches.

REFERENCES


