Abstract— Diabetic retinopathy is major eye complications produced by the diabetes mellitus, which causes other problems such as stroke, cardiovascular disease, diabetic nephropathy and diabetic neuropathy. Diabetic retinopathy consequences in visual conflicts and can lead to permanent blindness. Therefore, a regular diabetic retinopathy screening is essential for early treatment, along with an effective risk factor management to overcome the diabetic complications and reduce morbidity and mortality influence. In this paper we perform the digital image processing techniques to extract the retinal blood vessels. This algorithm is tested on STARE database.

Keywords— Retina, Fundus, Blood Vessel, Diabetic Retinopathy

I. INTRODUCTION
Numerous clinical studies shows the relationship between alterations in the topologies of the human retinal blood vessel, the projection and the disease growth, such as diabetic retinopathy, hypertensive retinopathy, and macular degeneration. Certainly, the detection of these vascular changes always has gaps. The manual steps are slow, which may be subjected to a bias of the perceiver. Author presents this paper to investigate a new method for measuring the blood vessel diameter in the retinal image [1]. Diabetic Retinopathy, which is one of the primary root of visual death and visual impairment in middle aged patient. The present learning focus is developing the extraction of normal and isolated characteristics or marks in color retinal images. The adaptive filters are tuned to match the part of vessel to be extracted in green channel images. To classify the pixels into vessels and non-vessels the Biogeography Based Optimization Algorithm is applied [2].

II. METHODOLOGY
Diabetic retinopathy lesions are extracted by the following expressions.

\[ g = \frac{G}{R + G + B} \]  

Here g is a Green channel and R, G and B are Red, Green and Blue respectively. Because green channel shows the high intensity as compare to red and blue respectively.
b. **Histogram Equalization:**

\[ h(v) = \text{round} \left( \frac{\text{cdf}(v) - \text{cdf}_{\text{min}}}{(M \times N) - \text{cdf}_{\text{min}}} \times (L - 1) \right) \]  

(2)

Here \( \text{cdf}_{\text{min}} \) is the minimum value of the cumulative distribution function, \( M \times N \) gives the image's number of pixels and \( L \) is the number of grey levels. Histogram equalization is used for enhancement of a green channeled image for extracting more fine details of fundus image.

c. **Complement:**

\[ A^c = \{ \omega \mid \omega \notin A \} \]  

(3)

Here \( A^c \) is a complement \( \omega \) is the element of \( A \), \( \notin \) stands for not an element of \( A \) and \( A \) is set. Complement function is used on histogram equalization for enhancement.

d. **Intensity Transformation Function:**

\[ s = T(r) \]  

(4)

Where \( T \) is Transformation and \( r \) is Intensity. Intensity transformation function is used on complement image for extracting the Microaneurysms.

e. **Threshold:**

\[ T = \frac{1}{2}(m1 + m2) \]  

(5)
Here m1 & m2 are the Intensity Values. Threshold function is used for feature extraction of the fundus image.

f. **Morphological Opening:**

\[
A \circ B = (A \ominus B) \oplus B \quad (6)
\]

The opening of A by B is obtained by the erosion of A by B, followed by dilation of the resulting image by B.

g. **Morphological Closing:**

\[
A \circ B = (A \oplus B) \ominus B \quad (7)
\]

The closing of A by B is obtained by the dilation of A by B, followed by erosion of the resulting structure by B.

III. RESULT

For extraction of retinal blood vessels we use Digital Image Processing techniques and MATLAB 2012a. First of all we extracted the red, green and blue channel from color fundus image. We selected the green channel because this channel shows the high intensity pixels as compare to red and blue. Afterwards apply histogram equalization for image enhancement afterwards apply image complement function, intensity transformation and so on, as describe in figure 1. Following figure shows the output of retinal blood vessels using digital image processing techniques.

**REFERENCES**


