A Novel Method of WBC Detection Using Differential Evolution

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***Abstract* - For biological research the microscopy cell image analysis is a fundamental tool. In human body blood cells are divided in three general categories RBC (Red blood cells), WBC (White Blood Cell) and Platelets. White Blood Cell detection is one of the most basic steps in automatic detection system of white blood cells in microscopic blood images. Here differential evolution algorithm is used to find and detect white blood cells in microscopic blood smear images which image also contain RBC and Platelets. Ellipse detector is used to draw ellipse around the WBC cells in ellipse shape which detect WBC particle more effectively, more accurately and its stability greatly affect on an operating speed of the system.**

***Keywords*- WBC (White Blood Cell), Differential Evolution Algorithm, Microscopic blood smear images, RBC (Red blood cells, Ellipse detector.**

I. INTRODUCTION

The cells that circulate in the bloodstream are generally divided into three types: white blood cells (WBC), red blood cells (RBC), and platelets [9]. Abnormally low or high counts of blood may detect and indicate the presence of many forms of disease, and hence blood counts are amongst the generally performed blood tests in medicine, as they can provide an overview of a patient's general health status. From the result of blood cell images specially on an WBC, it can be said that normal number of WBC in average human adult was about 45000 to 10000 of WBC per liter, about 1% of total blood cell in the body and this normal quantity of WBC is important to ensure person healthiness [2]. Large number of WBC may indicate an infection. The main objective of this project is to determine easier and simple method for detecting white blood cell in the blood sample images. The scope of this project to analyze some blood smears image samples. Ellipse detectors target the vector and select the number of different vector is used and the way that crossover points are determine. It draw an ellipse around the WBC by using differential evolution algorithm. By using this technique WBC is detected easily.

II. METHODOLOGY

Differential evolution (DE) is developed by Rainer storm and Kenneth Price in 1997 for computing problems over continuous domain. Differential Evolution (DE) is one of the Evolutionary Algorithm [2]. In DE each variables value is represented by a real number. The features of DE are its simple structures, easy to use, accuracy, speed and robustness. Differential Evolution is a design tool of great utility that is quickly accessible for practical applications. DE has been used to discover effective solutions to nearly same as that of intractable problems without appealing to expert knowledge or complex design algorithms [8]. DE includes Genetic Algorithms, Evolutionary Strategies and Evolutionary Programming

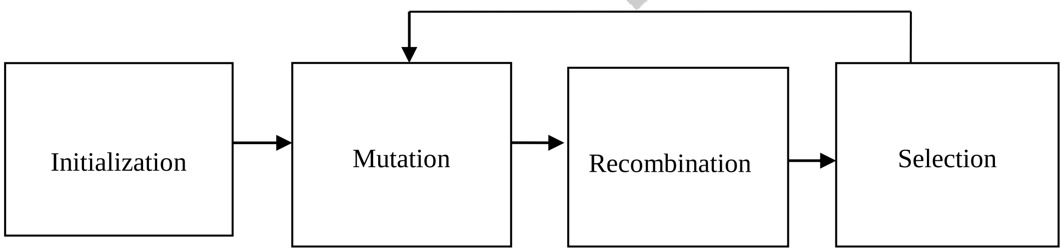

Figure1: General Evolutionary Algorithm Procedure

A. Notation: Suppose we desire to optimize a function with D real parameters not imaginary one. We must select the size of the population N (it must be at least four). The parameter vectors have the form:

$$x_{i,G} = [x_{1,i,G}, x_{2,i,G}, \ldots x_{D,i,G}]$$

$$i = 1, 2, \ldots, N.$$

Where, G is the generation number.

B. Initialization: Define upper and lower bounds for each parameter:

$$x_j^L \leq xj, i, 1 \leq x_j^U$$

Randomly select the initial parameter values uniformly on the intervals $[x_j^L,\ x_j^U]$

C. Mutation: Each of the N parameter vectors undergoes mutation, recombination and selection. For a given parameter vector xi, G randomly select three vectors one by one (xr1, G), (xr2, G) and (xr3, G) such that the indices r1, r2 and r3 are distinct. Mutation operator is the prime operator of DE and due to implementation of this operation DE gets different from other evolutionary algorithms. The mutation operation of differential evolution (DE) applies the vector differentials between the existing population members for determining both the direction and degree of perturbation applied to the individual subject of the mutation operation [6].

D. Recombination: From the previous generation recombination incorporates successful solutions. The trial vector ui, G+1 is improved from the elements of the target vector (xi, G) and the elements of the donor vector (vi, G+1). Elements of the donor vector and the trial vector with probability CR Recombination [7].

uj ,i,G+1 = $\begin{cases} vj, i, G+1 & \text{if randj, i} \leq \text{CR or j} = \text{Irand} \\ xj, i, G \; if \; randj, i > CR \; and \; j \neq Irand \end{cases}$

i = 1, 2, . . . ,N;

j = 1, 2, . . . ,D;

randj,i _ U[0, 1], Irand is a random integer from [1, 2, ...,D]

Irand ensures that vi,G+1 6= xi,G.

E. Selection: The target vector xi, G is compared with the trial vector vi, G+1 and the one vector with the lowest function value is admitted to the next generation,

Xi, G+1 = $\begin{cases} \text{ui, G} + 1 & \text{if f(ui, G} + 1) \leq \text{f(xi, G)} \\ \text{xi, G} & \text{Otherwise} \end{cases}$ i = 1, 2. . . N

III. RESULT AND DISCUSSION

Differential evolution method is used to develop computer vision method for white blood cell detection [8]. This detection task is approached as an optimization problem and the differential evolution is used to build the ellipsoidal approximation. DE is used to optimize complex continuous nonlinear functions for automatic white blood detection. In this paper the propose technique uses the encoding of five edge points as candidate ellipses in the edge map of the smear. An objective function allows to accurately measuring the resemblance of a candidate ellipse with an actual WBC on the image. Directed by the values of such objective function, the set of encoded candidate ellipses are evolved using the DE algorithm so that they can fit into actual WBC on the image [4]. Some features are there of DE algorithm such as its simplicity, ease of implementation, fast convergence, robustness and accurate, reporting a wide range of successful applications in the literature [3–5]. The approach generates a sub pixel detector which can effectively identify white blood cells in real images. Experimental result shows the effectiveness and accuracy of such method in detecting leukocytes despite complex conditions. Comparison to the state-of-threat WBC detectors on multiple images demonstrates a better performance of the proposed technique.

The main contribution of this study is the proposal of a new WBC detector algorithm that recognizes WBC cells under different and complex conditions while considering the whole process as problem in ellipse detection. Although ellipse detectors based on optimization present several interesting properties, to the best of our knowledge, they have not been applied to any medical image processing up to date.

A. Algorithm

Step 1: Preprocessing –parts divide in WBC, RBC and Platelets

Step 2: Segment the WBC’s using the DEM algorithm

Step 3: Start the ellipse detector based in DE over the edge map while saving best ellipses and show best fit.

Step 4: Define parameter values for each ellipse that identify and draw ellipse around the WBC’s.

B. Flow Diagram

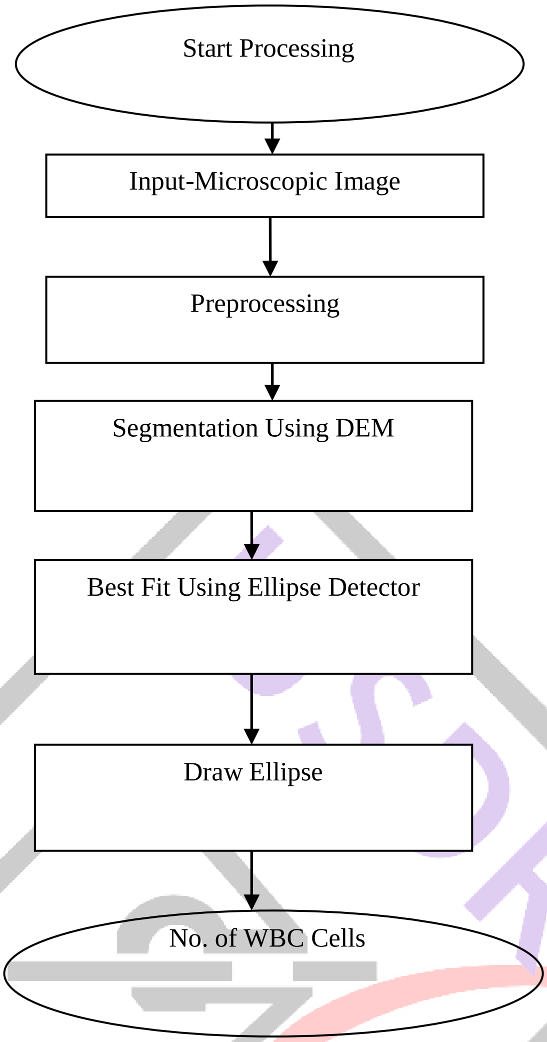

Figure2: Flowchart Diagram of Detection of WBC

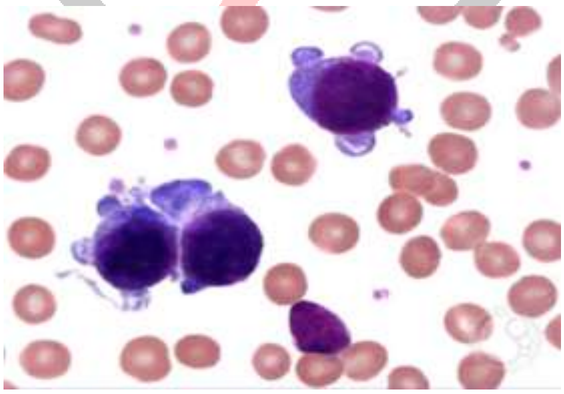

Figure 3. Microscopic Blood Smear Image Which Include 3 Types of Cells RBC, WBC And Platelets

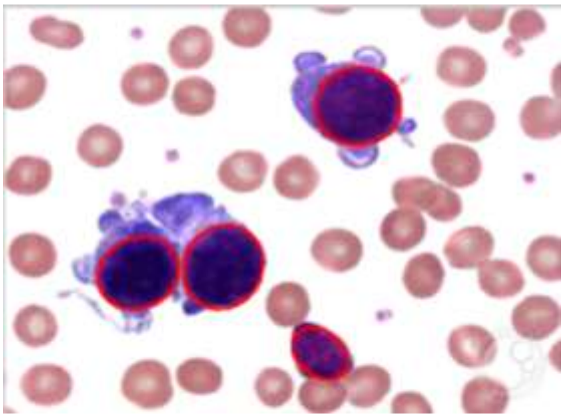

Figure 4. WBC Detection Using Differential Evolution Ellipse Detector Detect By Draw Ellipse Around The WBC Cell And Identify WBC.

IV. CONCLUSIONS

In this paper, ellipse detector is an algorithm for the automatic detection of white blood cell images based on the DE algorithm has been presented. The approach considers the complete process as a multiple ellipse detection problem. The proposed technique uses the encoding of five edge points as candidate ellipse in the edge map of the smear microscopic image. An objective function allows to accurately measuring the resemblance of a candidate ellipse with an actual WBC on the particular image.

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