

# “An Automatic System for Detecting and Counting RBC and WBC Using Fuzzy Logic”

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**Abstract:** The human blood consists of the RBCs, WBCs, Platelets and Plasma. Blood is a health indicator therefore segmentation and identification of blood cells is very important. Complete Blood Count (CBC) includes counting of all the cells which determines persons health. The RBC and WBC count very important to diagnose various diseases such as anemia, leukemia, tissue damage etc. Old conventional method used in the hospital laboratory involves manual counting of blood cells using device called hemocytometer and microscope. But this method extremely monotonous, laborious, time consuming and leads to the inaccurate results due to human error. Also, there are some expensive machines like analyzer, which are not affordable by every laboratory. The objective of this paper is to produce a survey on an image processing-based system that can automatically detect and count the no of RBCs and WBCs in the blood sample image. Image acquisition, pre-processing, Image enhancement, image segmentation, Image post-processing and counting algorithm these are six steps involved in an image processing algorithm.

## I. INTRODUCTION

**Necessity of blood count:** The Complete Blood Count (CBC) is the blood test used to evaluate the health of person and to detect the disorders like anemia, infection and leukemia. In medical diagnosis complete blood count is very important. There are mainly four categories of cells: Red Blood Cells (RBCs), White Blood Cells (WBCs), Platelets and Plasma. These groups can be differentiated using texture, color, size, and morphology of nucleus and cytoplasm. Cells count is important to determine the immunity and capability of the body system. The abnormal count of cells indicates the presence of disease and person needs medical help. Current research is on an implementation of image processing based on automated counting of RBCs and WBCs from blood image.

WBCs are also called leukocytes. These cells are an important part of immune system. These protects body by removing virus and bacteria in a body. Medical term use to describe low count is Leukopenia. Leukopenia indicate the presence of infection. Medical term used to describe high count is leukocytosis. Leukocytosis indicate an existence of infection, leukemia or tissue damage. RBCs are also known as erythrocytes. The function of RBC is to carry oxygen and collects carbon dioxide from a lung to the cells of body. They contain protein called hemoglobin. The presence

Of inner and outer layers of protein gives red color to blood. Hemoglobin do the work of carrying oxygen. An abnormal count of RBCs leads to anemia which results in mental tiredness, illness, weakness, dizziness. If it is not treated immediately it results into more serious symptoms like malnutrition and leukemia. RBC indicates gives information about size and shape of cels and are also useful in differentiating types of anemia.

## II. METHODOLOGY

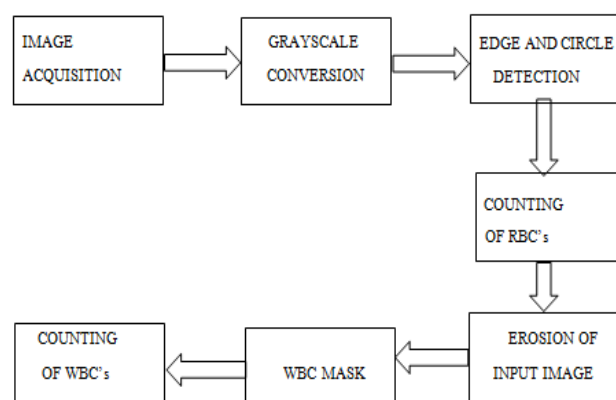


Figure 1: Block diagram

**Description:** The GB image (input blood smear image) obtained is converted using gray scale image and the edges are detected using fuzzy logic rules. Now the center of the circle is found and the radius is determined for each cell. Using this total number of blood cells is counted. Based on the presence of the nucleus the cells are determined if they are red blood cells or white blood cells and the count is displayed on the GUI i.e., graphical user interface. The steps involved are explained briefly below.

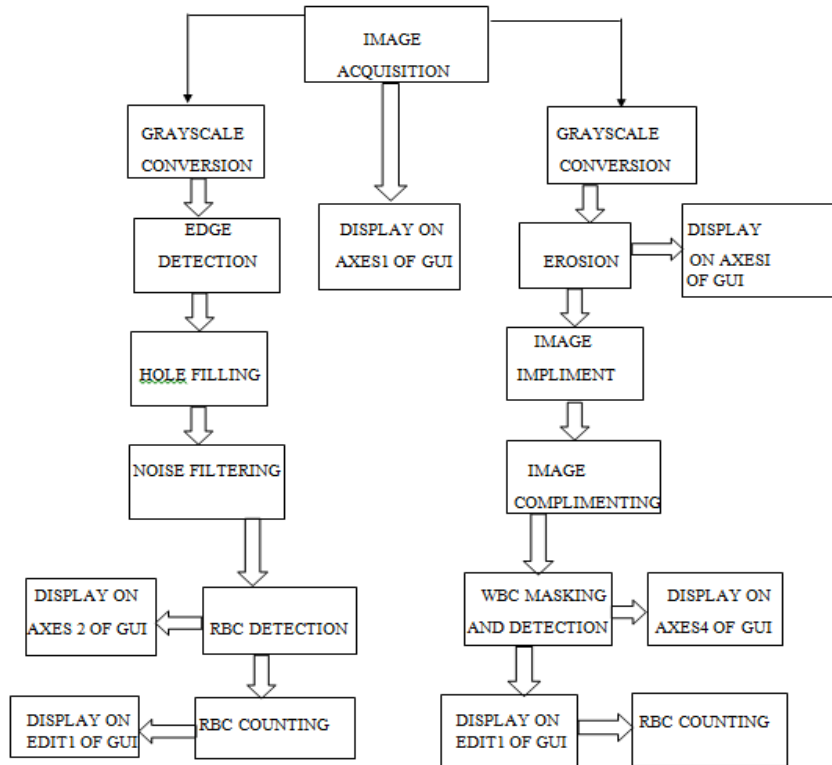


Figure 2: Flow chart

**1. Gray scale conversion**

Import the blood smear image as shown in the figure 1. For illustration consider image of a blood smear from a laboratory. The image is given in an RGB format and then converted to grayscale.

Syntax: I=rgb2gray (RGB)

Where RGB is the image name. The gray scale image is shown in figure 4 for RBC counting, extract the RBCs.

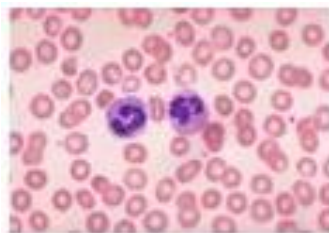


Figure 3: Blood smear image

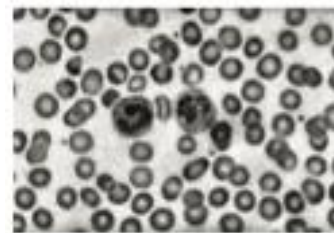


Figure 4: Gray scale image

**2. Edge detection**



Figure 5: RBC mask obtained from canny logic

The canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images. Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed. It has been widely applied in computer vision systems.

### 3. Image filtering using median filters

In our project we use this command to filter the noise in the edge detected image, so that only the RBC cells can be detected as circles and not the noise.

MEDFILT:

2-D median filtering

SYNTAX:

J=medfilt2(I)

J=medfilt2(I,[m,n])

DESCRIPTION:

J=medfilt2(I)-performs median filtering of the image in two dimensions.

Each output pixel contains the median value in a 3-by-3 neighbourhood around the corresponding pixel in the input image. Examples: Remove Salt and Pepper Noise

### 4. Image complement and hole filling

The obtained image is complemented for better identification and the resultant image is shown in figure 6. Hole filling operation and labeling is performed on the resultant image and is shown in figure 7.

For image complementing the instruction “imcomplement” is used.

IMCOMPLEMENT:

Complement image

SYNTAX:

J= imcomplement (I)

DESCRIPTION

J=imcomplement(I) computes the complement of the image I and returns the results in J.

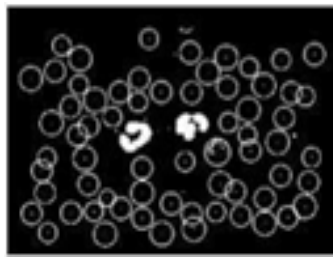


Figure 6: Complementated image

The hole filling is performed using the instruction “imfill”.

IMFILL

Fill image regions and holes

SYNTAX:

BW2 = imfill (BW, locations)

BW2 = imfill (BW, locations, conn)

BW2 = imfill (BW, “holes”)

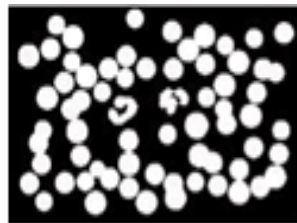


Figure 7: Hole filling process

### 5. Differentiation of RBC and WBC

Based on the presence of nucleus and the intensity values WBCs are differentiated from the RBCs. Erosion is applied on the nucleus of the WBC and the WBC cells are separated from the RBC. The extracted WBC masks are shown in figure 8. The erosion is performed using the instruction “imerode”.

IMERODE

Erode image

SYNTAX

J = imerode (I,SE)

J = imerode (I, nhood)

J = imerode (packopt, m)

J = imerode (shape)

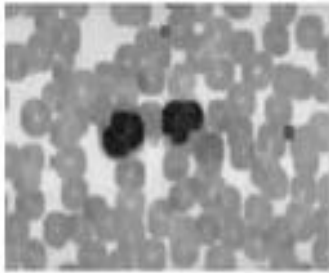


Figure 8: Erosion on input blood smear image

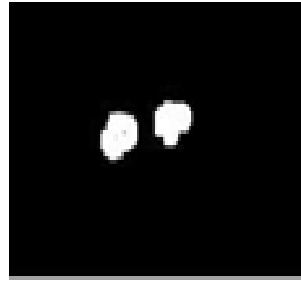


Figure 9: WBC mask

### 6. Counting of blood cells

The counting process is done based on the obtained center and the radius values by using a simple circular hough transform code developed for cell counting. Counting of RBC using Circle Hough Transform. The Circle Hough Transform (CHT) is a feature extraction technique for detecting circles. It is a specialization of Hough Transform. The purpose of the technique is to find circles in imperfect image inputs.

SYNTAX:

```
Centers = imfindcircles(A,radius)
[centers, radii] = imfindcircles (A,radiusRange)
[centers,radii, metric] = imfindcircles (A,radiusRange)
```

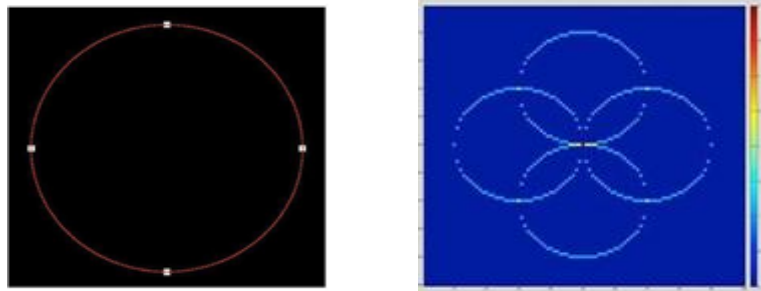


Figure 10: Example for CHT

### III. SOFTWARE DESCRIPTION

The name **MATLAB** stands for **MATRIX** Laboratory. **MATLAB** was written originally to provide easy access to matrix software developed by the **LINPACK** (Linear system package) and **EISPACK** (Eigen system package) projects. **MATLAB** is a high- performance language for technical computing. It integrates computation, visualization, and programming environment. Furthermore, **MATLAB** is a modern programming language environment; it has sophisticated data structures, contains built-in editing and debugging tools, and supports object-oriented programming. **MATLAB** is interactive system whose basic data element is an array that does not require dimensioning. The software package has been commercially available since 1984 and is now considered as a standard tool at most at universities and industries world wide. It has a powerful built-in routine that enable a very wide variety of computations. It has also easy to use graphics that make the visulaisation of results immediately available. Specific applications are collected in packages referred to as toolbox. There are toolboxes for signal processing, symbolic computation, control theory, simulation, optimization, and several other elks of applied science and engineering.

#### A. USES OF MATLAB

**MATLAB** is widely used as computational tool in science and engineering encompassing the fields of physics, chemistry, math and all engineering streams. It is used in a range of applications including:

- Signal processing and communication
- Image and video processing
- Control systems
- Test and measurements

#### B. GRAPHICAL USER INTERFACE (GUI)

GUIs (also known as graphical user interfaces or UIs ) provide point-and-click control of software applications, eliminating the need to learn a language are type comments in order to run the applications.

MATLAB apps are self-contained MATLAB programs with GUI front ends that automate a task or calculation. The GUI typically contains controls such as menus, toolbars, buttons and sliders. Many MATLAB products, such as curve fitting toolbox, signal processing toolbox, and control system toolbox include apps with custom user interfaces. You can also create your own custom apps, including their corresponding UIs, for others to use.

In our project have created a GUI to display the following 4 axes and 2 edit box to display the output :

1. input image
2. RBC detected image
3. eroded image
4. WBC detected image
5. RBC count box and
6. WBC count box

The GUI also includes 4 push buttons which has coded in the background in the editor window and some static text boxes to show information to the user.

The GUI is as shown in the figure 11:

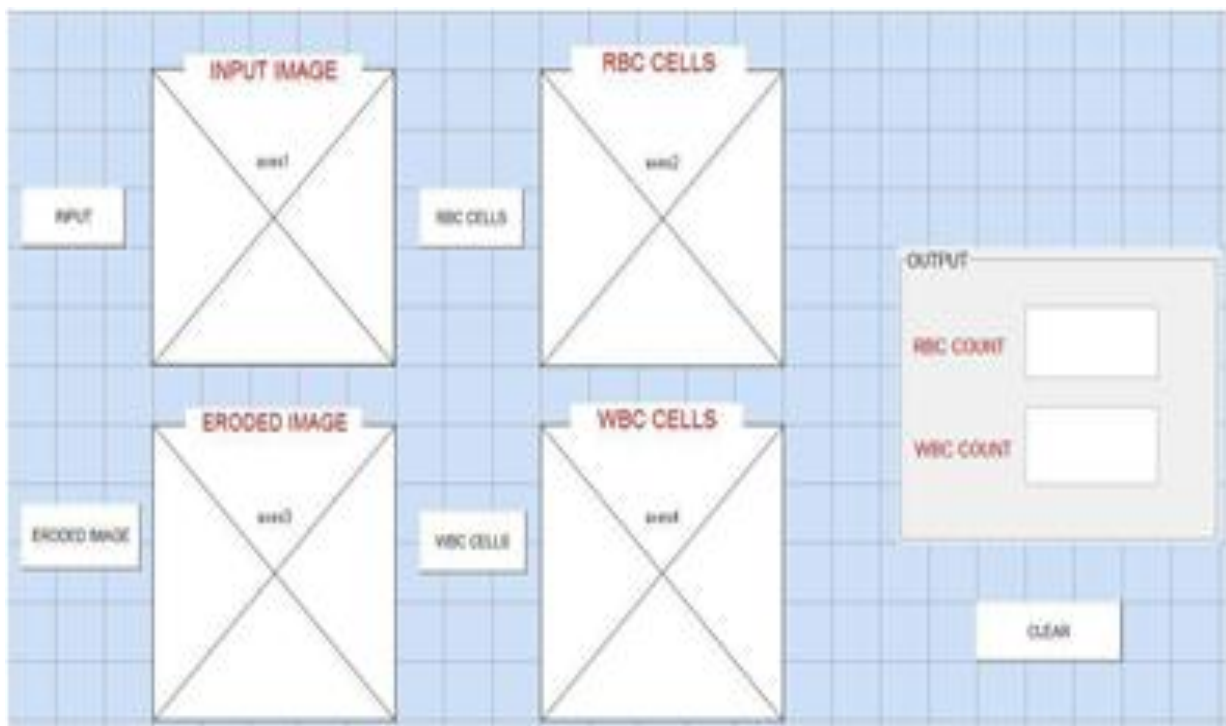


Figure 11: GUI

### IV. EXPERIMENTAL RESULT

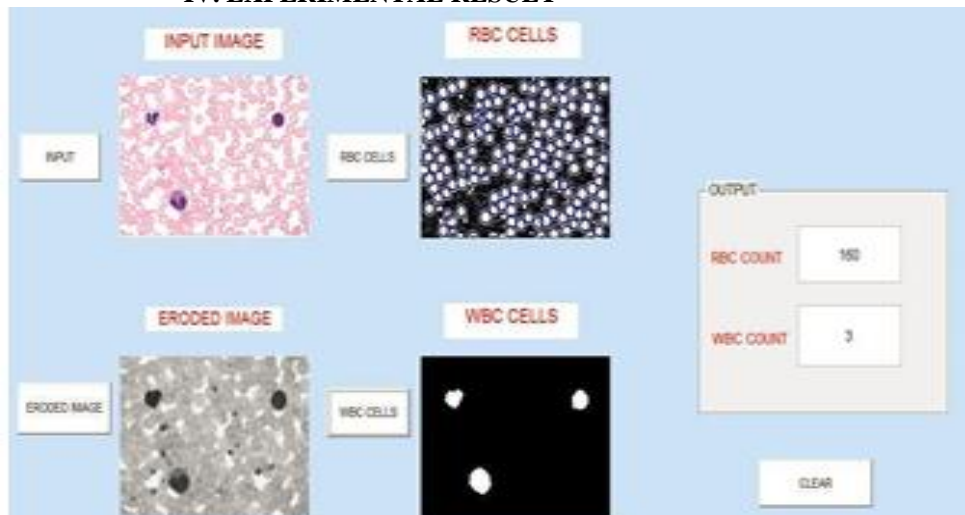


Figure 12: Resultant image



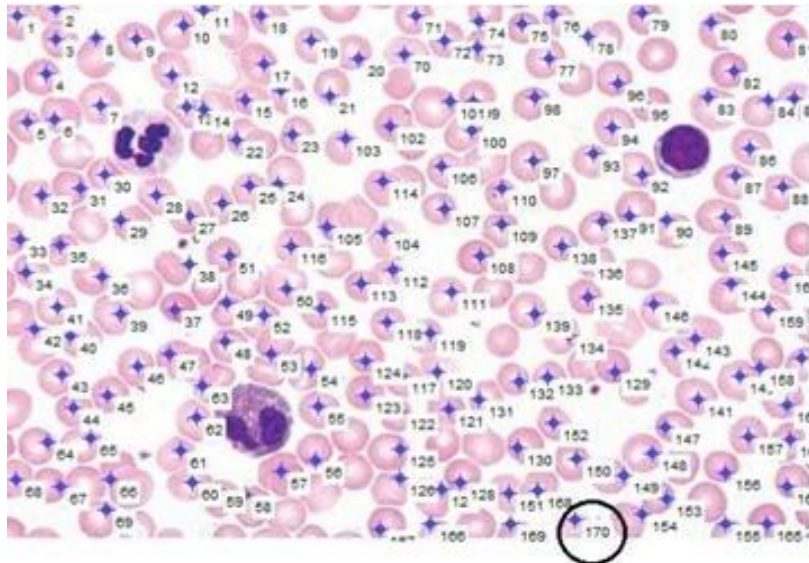


Figure 13: Manual count of RBC

## V. CONCLUSION

The goal of this paper is to produce cost effective and efficient computer vision system for automatic counting of blood cells from the blood smear microscopic image. In this project we have detected and counted RBCs using the canny edge detection and circular hough transform and have detected and counted WBCs using erosion and labeling. The manual count of RBC varies with the automated count within a range of +15 to -15 and the WBC count values is found to be almost same in every case. This algorithm provides accurate count and the time taken to complete the process is also very less.

## REFERENCES

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