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An Economical Approach to Blood Cell Counting Using Modified Hough Transform

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ABSTRACT: In this paper, we tries to introduce an efficient and economical computer vision system for automatic blood cell counting using image based analysis, which minimizes the stress on the technician and whose output is reliable and accurate. In this paper, a software based approach is used to count a number of blood cells from the blood sample image taken by the digital camera attached with the microscope. In the pre-processing step, the original blood sample image is converted into saturation image. Segmentation is done by histogram thresholding. Next step, feature extraction is done by differentiating a red blood cell from other cells and background. The final step is to calculate the number of blood cell from the blood sample image by using Circular Hough Transform technique.

KEYWORDS: K - means clustering, Binarization, Edge detection, Hough Transform and Circular Hough Transform.

I.INTRODUCTION

In this work, the centre point of our study is medical images. Hospitals and medical institutions produce large number of medical images in digital format. Tedious task is how to use this huge amount of images effectively. In the field of biomedicine, cells are important. Cell's structure is complex in nature; it still remains a challenging task to segment cells from its background and count them automatically. Counting problem arises in many real world applications including cell counting in microscopic images, monitoring crowds in surveillance systems and performing wildlife census. The microscopic inspection of blood slides provides important qualitative and quantitative information.

The human blood consists of three types of blood cells such as red blood cell (RBC), white blood cell (WBC) and platelets (PLT). Red blood cells are most important and major elements of blood. According to the American Cancer Society (2009), the normal red blood cells in our body is divided into four categories of ages, which are new born, children, women and men. (The normal red blood cells in our body are shown in the table 1.1.) The main functionality of red blood cells is to supply oxygen throughout the body. So red blood cells are important cells to survive. We may suffer fatigue and shortening of breath when the haemoglobin level is too low due to insufficient oxygen supply. High red blood cells count in our blood can create problem. Common symptoms include blurred vision, headaches, and high blood pressure. Therefore, RBC count is very important for the diagnosis of many diseases. In this paper, we aim on the problem of identifying and counting blood cells by microscopic images. The proposed work separates the red blood cells from the other blood cells (WBC, PLT) in the blood cell images by using Hough Transform and it counts the number of red blood cells in the images. The total work has been done on MATLAB platform.

Table 1.1: Normal range of red blood cell

Categories of human being	**Number of RBC per microliter in million**
New-born	4.8 to 7.2
Children	3.8 to 5.5
Women	4.2 to 5.0
Men	4. 6 to 6.0

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II.BACKGROUND AND RELATED WORK

A. Traditional System

In the old conventional method of cell counting, microscope is used. A blood sample is taken from patient and then a film is prepared from that sample, which can be visualized under the optical microscope. A well trained laboratory technician is responsible for manually separating blood cells from other cells and counting the particular cells. This method seems to be easy but it totally depends on the technician to give the correct and precise result, and the result depends on the skills of technician to perform at his/her best performance. This manual counting of cell under the microscope is repetitive and time consuming task. In this method, complex structure of cell is challenging to count blood cell accurately. Blood cell counting under the microscope gives unreliable and inaccurate result. This method puts lots of pressure on technician.

B. AUTOMATIC HAEMATOLOGY ANALYSER

Another method for Blood counting is the automatic haematology analyser. This is widely used for counting the blood cell. This method is still largely used in blood analysis process. Blood sample is taken from patient and this sample is taken into test tubes. This involves placing these test tubes of blood into racks of analyser, and moved along with high speed. This method reduces manual work load of counting blood cells, avoids human errors and guarantees more safety of laboratory staff.

Every haematology analyser returns complete blood cell count (CBC) and three or five part WBC differential. This machine is very costlier. So it is not possible for all the hospital's clinical laboratory to implement such an expensive machine to count the blood cell in their laboratory.

C. VENKATALAKSHMI B,Thilagavathi K, "Automatic Red Blood Cell Counting Using Hough Transform"[1]

In this paper, the authors' tries to present an efficient, worthwhile and economical computer vision system for automatic red blood cell counting, which reduces the stress on the technician and whose output is reliable and accurate.

A digital camera is attached to the optical microscope. Blood sample image is taken from that camera. Software based approach is used to count the red blood cell from the sample image. Five steps are involved in the process of counting the red blood cells. Those are as follow:

1. Input image acquisition
2. Pre-processing
3. Segmentation
4. Feature extraction and
5. RBC counting.

Image pre-processing is the method of adjusting images that are suitable for the next step of computational process. Here in this work, the original blood sample image is converted intoHSV/saturation image. There is need to convert the RGB i.e. original image into HSV image, because HSV color model show the color similarly to how human eye tends to see the color.

Next step is the Segmentation, which is done by histogram thresholding. Image segmentation is the process of dividing a digital image into multiple segments. Thresholding is the simplest method of image segmentation. This method is totally based on the threshold values, to convert the greyscale image into binary image.

Next step, feature extraction is done by differentiating a red blood cell from other cells (WBC and platelets) and background. The final step is to find out the number of red blood cell from the blood sample image by using Hough Transform technique.

The author gives the idea of future work, which will focus on complete blood cell count like white blood cell and platelets using appropriate segmentation and counting algorithm based on the shape and size of the cells.

Three main techniques are used to calculate the number of red blood cells in the blood sample image which are logical, morphological and hough transform. Figure1shows the complete flow chart of proposed system.

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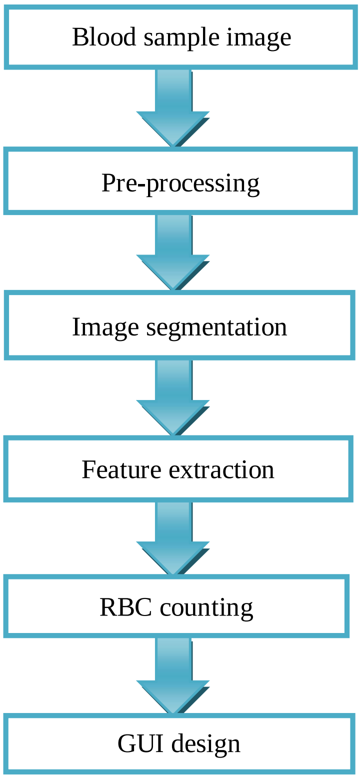

Figure 1. Flowchart of RBC counting process

D. Rahul Kumar Gupta and Manali Mukherjee, "Detection and Counting of Red Blood Cells in Blood Cell Images using Hough Transform"[11]

In this paper, the author's purpose of the work is to count the number of red blood cells in a given blood sample. For this he has applied various pre-processing techniques like edge detection, spatial smoothing filtering and adaptive histogram equalization to detect and extract the red blood cells from the images. Feature extraction has been done through the Hough Transform method which has been used to find out the red blood cells based on their sizes and their shapes. This isolates the red blood cells from the rest of the image of the blood sample so that further processes like counting can be applied exclusively on them.

The Hough transform [14] is a feature extraction technique used in image processing and computer vision. It was initially suggested as a method for line detection in edge maps of images, and then extended to detect general low-parametric objects such as circles [5, 13]. To detect a straight line in an n X n image, the simplest method is to compute all possible lines defined by every pair of points in the image and then find all subsets of points that are closed to particular line. The computation involved will be enormous because the maximal possible line is n (n-1)/2 ~ n2 and then (n) [n (n-1)]/2 ~ n3. Comparisons need to be performed for each and every point in the image. The problem is solved using Hough Transform that uses the parametric description of the shape to reduce the computation involved. Considering two points (x1, y1) and (x2, y2) in the x-y plane, the line equation is:

$$yi = axi + b, \quad (1)$$

Rewriting the equation

$$b = -axi + yi \quad (2)$$

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Two points are represented in the x-y as well as a-b plane. The first point (x1, y1) and the second point (x2, y2) each yield a line in the a-b plane and both the lines intersect at a point and this is also true for all the points contained in the line. Using this unique feature a parameter space called as the accumulator cell or Hough space is created with a-axis and b-axis having a min and max of the expected range. The same method used for the detection of straight lines can also be extended for the detection of circle and the equation is:

$$(x-a) 2 + (y-b) 2 = r2 \qquad (3)$$

Having successfully isolated the red blood cells we have applied a counter that has counted the number of RBC's in the image field.

E. Rahul Kumar Gupta and Manali Mukherjee, "Detection and Counting of Red Blood Cells in Blood Cell Images using Hough Transform"[11]

In this paper, Counting chambers with appropriate volumes and grids to facilitate counting through visual inspection are typically used. Neubauer, Burker and Fuchs-Rosenthal are well known chambers with accurate marked regions. The Neubauer chamber, presented in Fig. 2, is used in this work because it includes regions adequate for counting both high and low concentration of elements of interest.
Image acquisition An Olympus BX41 optical microscope with a 20X planar objective was used. An Olympus DP12 digital camera with 2048x1536-pixel resolution is used to save images in lossless JPG compressed format.
Counting methods: Two counting methods were used for evaluating the proposed method as mentioned below:

VISUAL COUNTING

Blood samples were visually counted using Neubauer chambers.

COMPUTER AIDED COUNTING

Computer aided software was developed for enabling expert and non-expert person to evaluate the RBC counting. Images focused at F1 are presented and the user selects the region where he/she believes there is a RBC. Marked images including RBC counting value cells (x, y) coordinates are saved for later comparison. Counted cells are coloured, in real-time for diminishing the occurrences of non-counted cells or cells counted twice. This on-the-fly counting feedback enables the user to promptly correct (1) a mark that was added in the absence of a cell or (2) a mark that was forgotten in the presence of a cell. By providing such error control, it is expected that this computer aided counting method generates more reliable results when compared to those from the typical visual assessment method made in laboratories where no image is registered. The counting was performed by an experienced biochemist (E.B.) and by two lay collaborators (L.C.) following the visual count standard procedure recommended by the International Council for Standardization in Haematology (ICSH). The E.B.'s counting result is considered the ground truth in this paper.

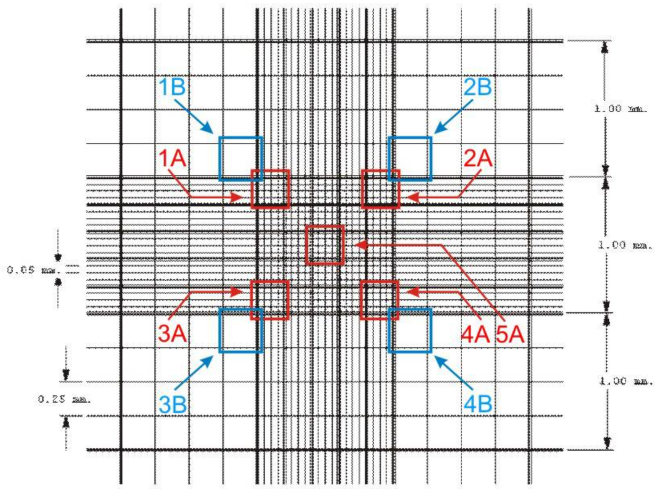

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Figure.2 Neubauer chamber with nine 1x1 mm2 squares. The chamber depth is 0, 1 mm resulting in a 0, 9 mm3 volume. The four squares in the corners are divided in 1/16 mm2 regions (e.g., 1B square). The central square is composed by 1/25 mm2 regions (e.g., 1A square) each on divided in 16 smaller regions with 1/400 mm2.

III.PROPOSED SYSTEM

Similar to the base paper, software based approach is used to count a number of blood cells i.e. red blood cell as well as white blood cell from the blood sample's image taken by the digital camera (CMOS camera) attached with the microscopic setup. There are five steps involved in the process of estimating the red blood cells. These are:

1. Input image acquisition,
2. Pre-processing,
3. Segmentation based on Feature,
4. Blood cell counting, and
5. GUI.

IV.RESULTS AND DISCUSSION

In first step, i.e. in input image acquisition blood sample's image taken by the digital camera attached with the microscopic setup. The digital camera attached with the microscopic setup is CMOS camera, which gives in uniformly focused image of blood sample not only centrally focused like in any ordinary digital camera. The figure 3 shows CMOS camera. The resolution of the Microscope is 40X or 100X, for clear vision the Microscope have one more lens attached on head part called as eye piece. To attach the CMOS camera we remove the eye piece of Microscope and fix it to the CMOS camera as shown in figure 4. The eye piece resolution is 5X or 10X.

Figure 3 CMOS Camera

Figure 4 Camera attached with Microscope

Then in second step i.e. pre-processing step the original blood sample's image shown in figure 5 is processed. In this process, the filtering and de-noising techniques are applied. For this technique similar to the K - means clustering are applied. Segmentation based on feature is the third step, in which colour feature of image is used. In this, the de-noised image is converted in different colour feature like RGB colour form as shown in figure 6 and HSV colour form as shown in figure 7.

Then the image is converted to gray form as shown in figure 8, then this gray image is converted into binary image i.e. binarization technique is applied on the gray image, this is done by histogram thresholding. The binarized image is shown as figure 9.Now at this stage the binary image is available, this image is given as input to the segmentation based on shape feature, in which we finds the edges of the all shape in the image of blood sample as shown in the figure 10.

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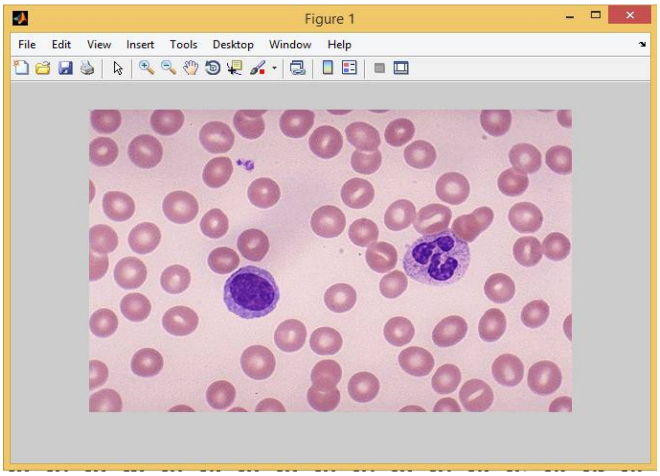

Figure 5 Original Blood Sample image

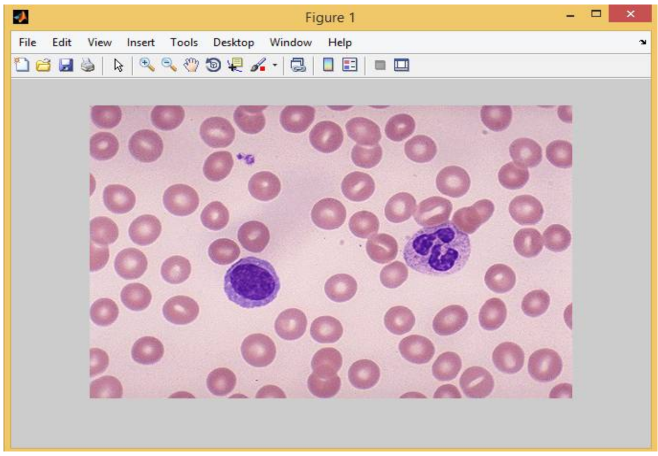

Figure 6 RGB image

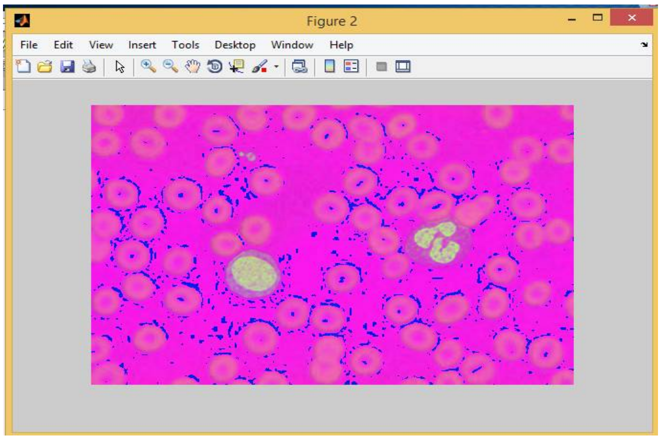

Figure 7 HSV image

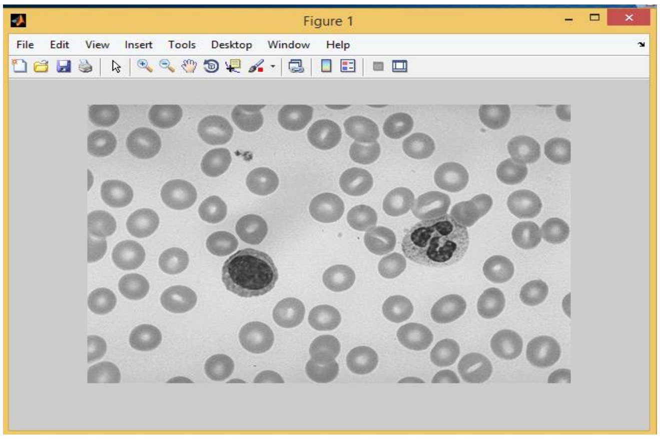

Figure 8 Gray image

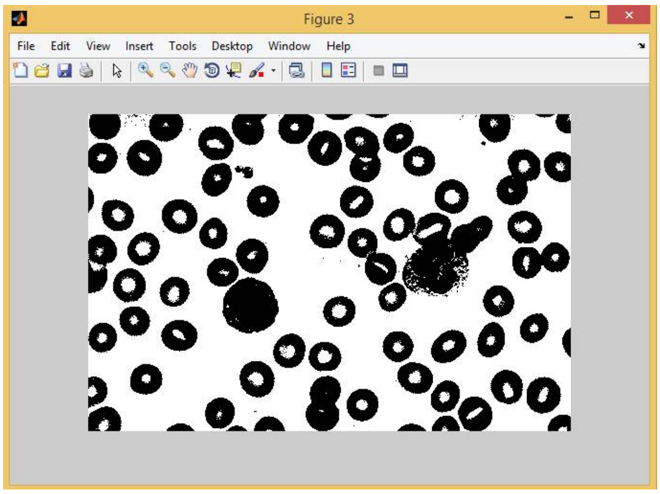

Figure 9 Binarized image

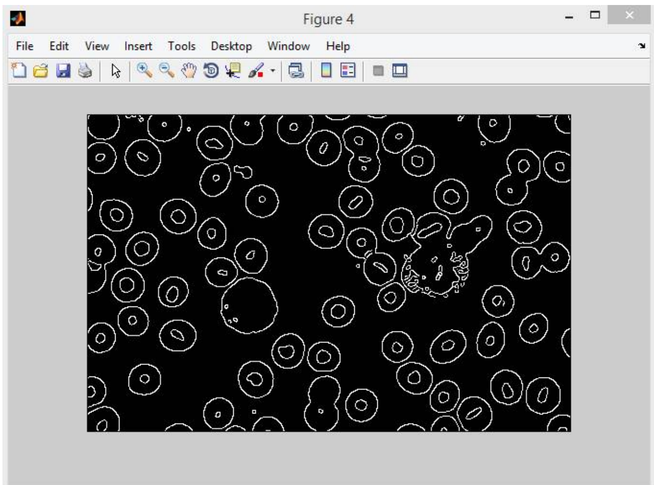

Figure 10 Edge image

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Then with the help of this edges and other feature, the extraction is accomplished through differentiating a red blood cell with other cells (WBC and platelets) and background and we differentiate white blood cell from others and background as well. The final step is to find out the number of red blood cell from the blood sample's image by using Hough Transform technique more clearly by using circular Hough transform.

Similar to base paper three main techniques are used to estimate the number of red blood cells and white blood cell in the blood smear image which are logical, morphological and hough transform. Figure shows the complete flow chart of proposed system.

In the figure 11 the GUI of the software is shown. The GUI is basically divided into two parts in first part, there is a provision to upload the image and then there are two buttons for the calculation of the RBC Counting and WBC Segmentation. Second part of the GUI consist a provision for the output to be display in which Figure is shown in container at right side and the total count of the Red Blood Cell. After uploading an image into the software, it is displayed on the output window as shown in the figure 12.

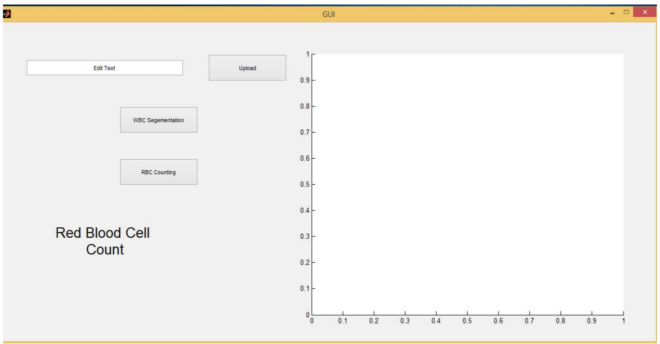

Figure 11GUI Of Software

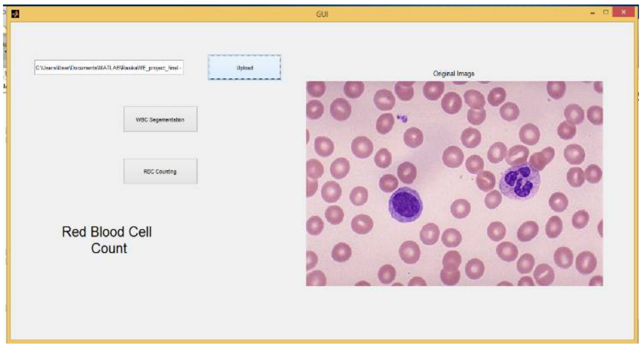

Figure 12 after Uploading in software

The results of this system is effective and efficient system, which is also a low cost system, which reduces the stress on the technician and it count the total number of cells in the blood that is red blood cell and also does the segmentation Of WBC.The figure 13 shows the results of the RBC Counting. Our system counts the Red blood cells and segments the WBC from the sample image. The figure 14 shows the result after execution of WBC Segmentation.

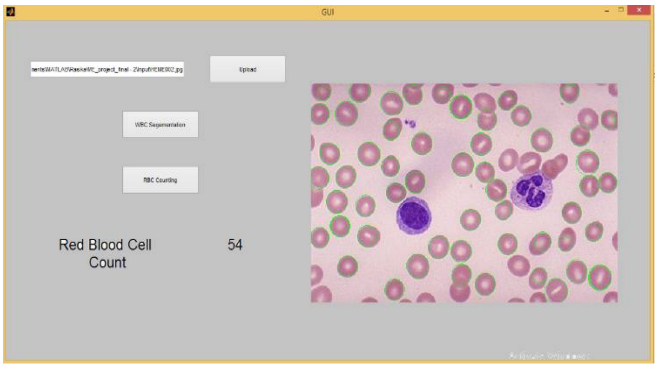

Figure 13 RBC Counting

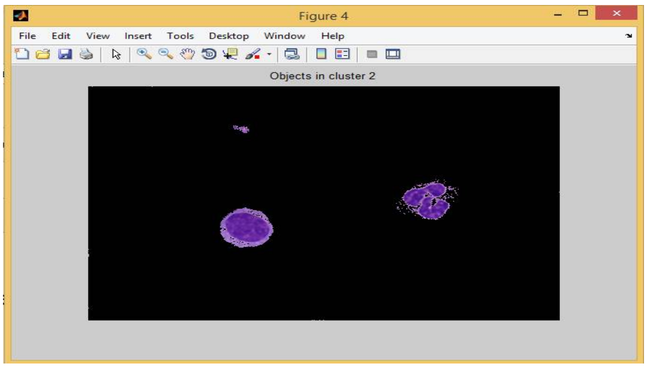

Figure 14 WBC Segmentation

V. CONCLUSION

The goal of this research work is to produce cost effective and efficient computer vision system for automatic detection of desired patterns from blood sample's microscopic images. Compare to manual counting it is less time consuming method. Manual counting method is tedious job and also gives inaccurate result, which is improved in this system.

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Automatic Haematology analyser also count blood cells but it is very costlier, when we are comparing with this system. This computer based automatic method will be implemented in real time microscopic image captured from the digital camera attached with microscopic setup, so blood cells are also not damaged.

REFERENCES

[1] Venkatalakshmi B, Thilagavathi K,"Automatic Red Blood Cell Counting Using Hough Transform", 978-1-4673-5758-6/13/$31.00 © 2013 IEEE

[2] M.Habibzadeh*a, A. Krzyaka, T.Fevensa, A.Sadrb." Counting of RBCs and WBCs in noisy normal blood smear microscopic images" SPIE 7963, Medical Imaging 2011: Computer-Aided Diagnosis, 79633I (March 08, 2011); doi:10.1117/12.878748.

[3] Blood cell histology -http://www.unomaha.edu/hpa/blood.html

[4] University of Utah Library: http://library.med.utah.edu/WebPath/HEMEHTML/ HEME005.html

[5] Duda, R.O. and P.E Hart, 1972. Use of the Hough transformation to detect lines and curves in picture Commun. ACM, pp: 11-15.K. M. Passino, "Biomimicry of bacterial foraging for distributed optimization," IEEE Control Systems Magazine, vol. 22, no. 3, pp. 52-67, 2002.

[6] Sirisak Liangwongson, Boonraung Marungsri, R. Oonsivilai, Anant Oonsivilai, "Extracted Circle Hough Transform and circle defect detection Algorithm", World Academy of Science, Engineering and Technology 60 2011.

[7] Rafael C.Gonalez, Richard E. Woods and Steven L. Eddins, "Digital Image processing Using MATLAB", Second edition.

[8] "The Diverse Exploding Digital Universe", An IDC white paper – Sponsored by EMC.

[9] Tom White, "Hadoop – The Definitive Guide" O'Reilly.

[10] "Childhood, adolescent and young adult cancer program, great information", UC Davis cancer centre and UC Davis Children's Hospital.

[11] Mausumi Maitra, Rahul Kumar Gupta and Manali Mukherjee, "Detection and Counting of Red Blood Cells in Blood Cell Images using Hough Transform".

[12] Claudio R. M. Mauricio,Fábio K. Schneider, and Leonilda Correia, "Image-Based Red Cell Counting for Wild Animals Blood", 32nd Annual International Conference of the IEEE EMBS Buenos Aires, Argentina, August 31 - September 4, 2010.

[13] R. O. Duda and P. E. Hart : Use of Hough Transformation to detect lines and curves in pictures, Comm. ACM, 15, pp 11-15 (1972).

[14] D. H. Baalard : Generalizing the Hough Transform to detect arbitrary shapes, Pattern Recognition, 13(2), pp.111-122 (1981).

[15] P. V. C. Hough : Method and means of recognizing complex patterns, U. S. patent 3069654, 1962