Circular Hough Transform and Region Based Methods for Counting of Red Blood and White Blood Cells.

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Abstract
Cells in the blood are major indicators of health. The number of cells in blood indicates the underlying illness and it will help to identify the source of illness. Blood cells are major biomarkers present in human body. Haemocytometer is the common and basic device which is used to count the blood cells. By appropriate staining procedures, we shall probably count different cells in the blood. RBC is stained using Haem's solution and WBC is stained using Turk's solution. This works involves the automatic counting of blood cells by merging the staining results with computer. The stained cells are captured with microscope and the same is interfaced with computer using ultra scope. The ultra scope output is called in MATLAB and major preprocessing steps like re sizing, RGB to Gray, histogram equalization is done. RBC image is then segmented based on shape using region based segmentation method and overlapped RBC's are identified by circular Hough transform. The WBC count is identified by subjecting WBC image to edge and region based segmentation methods. The segmentation algorithm will provide the count within given mm of blood. This method helps in avoiding man-made error that occurs during manual counting of cells using haemocytometer. Thus, the proposed method can be implemented to construct home based identification equipments.
Key words: RBC counting, WBC counting, Haemocytometer, Ultra scope, Blood cell counting, Circular Hough transform, MATLAB.

Introduction:

A microscopic image of a blood smear is frequently employed in categorizing and detecting illnesses that impact blood cells, as well as tracking down those who seek treatment for those conditions. The haemocytometer is always an essential tool for hematologists, medical practitioners for counting blood cells. Image processing in MATLAB is a method of performing operations on an image in order to obtain an enhanced image or to extract some multidisciplinary field, with contributions from various fields of science such as physics, mathematics, electrical and optical engineering, and others. The need to extract information from images and comprehend their content has been a driving force behind image processing's growth. It's employed in diagnostic imaging modalities like digital radiography, positron emission tomography (PET), computerized axial tomography (CAT), magnetic resonance imaging (MRI), and functional magnetic resonance imaging (FMRI) in medicine (firm). The complex image processing methods will be employed in a variety of applications, including vehicle identification, object recognition, and reconnaissance.

1.1: TYPES OF IMAGES:

The MATLAB tool box supports four types of images, namely indexed images, binary images, grey-level images, and RGB images. A description of those image types is given below.

1.1.1. Grey-level images:

It's also known as a monochromatic image since it uses 8 bits per pixel, with a pixel value of 0 indicating "black," a pixel value of 1 indicating "white," and intermediate values indicating various degrees of grey. These are similarly represented as a two-dimensional array of pixels, each with an 8-bit value.

1.1.2. Binary images:

Binary images have one bit per pixel, with 0 denoting 'black' and 1 denoting 'white.' The 2D array is used to represent the images. Binary images have a number of advantages, one of which is their small size.

1.1.3. RGB image:

Each color pixel in an RGB image is represented as a triple with the values of its R, G, and B components. An RGB color image correlates to a 3D array of dimensions M*N*3 in MATLAB. The image's height and width are represented by 'M' and 'N,' respectively, while the number of colored components is represented by 3. The range of values for an RGB picture of a class double is [0.0, 1.0], while the ranges for classes uint8 and uint16 are around [0, 255] and [0, 65535], respectively. Binary or grayscale images are used in the majority of monochrome image processing methods.

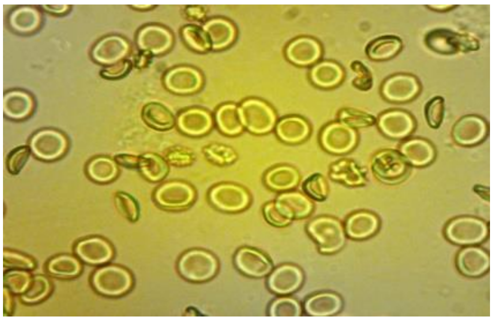


Figure: 1 Red blood cell

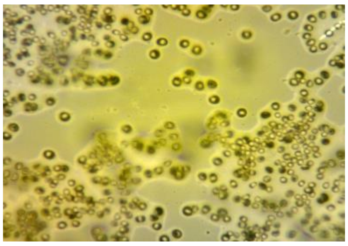


Figure: 2 White blood cell

1. TECHNIQUE:

The basic technique used for segmentation process is based on size and shape of the blood cells. RBC and WBC both have different method of segmenting. The following techniques are used for the segmentation process.

A. Circular Hough Transform (CHT): The Hough Transformation approach is the most extensively used method for counting the amount of Red Blood Cells. Edge detection utilizing gradient operators such as Prewitt and Sobel techniques, for example, have certain flaws. RBC is estimated and identified using this technique, which involves finding the circle's centre point. To recognize and draw circles, the circular Hough transform method is used. Two equations are used to describe the circle parameter.

$$Y = b + r \sin$$

$$X = a + r \cos$$

Where a and b are the circle's x and y centre's respectively, and r is the circle's radius. The following equation gives the parametric form of a circle:

$$r2 = (X a) 2 + (Y b) 2$$

B. Randomized Hough Transform (RHT): The RHT (Randomized Hough Transform) is a probabilistic variant of the Hough Transform that is commonly used to detect curves. A rapid RHT is a method for detecting circles that aims to improve RHT, which is less effective in complicated images due to its probability-based approach. They choose a seed point from the image by picking a random edge pixel.

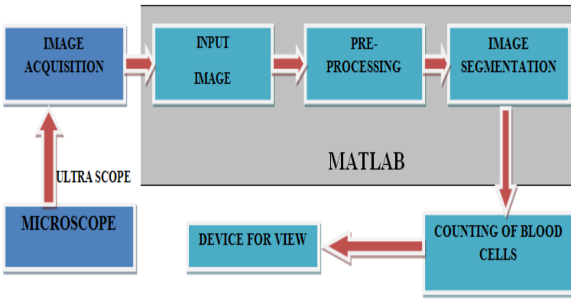
C. Randomized Circular Detection (RCD): RCD selects four edge pixels at random from the entire image. After that, the pixels are checked to see if they are non-collinear, and a circle is formed. Finally, a defined threshold value has been utilized to determine whether a true circle exists, or if the number of edge pixels sitting on a probable circle's boundary is sufficient.

2. COMPARISON

In comparison with Randomized Hough Transform and Randomized Circular Detection, Circular Hough Transform is more efficient in detecting overlapped cells and it gives the output with high proximity. The advantage of this method is that it detects pixels lying on one line. Thus, by the analysis made we have found that circular Hough transform is best suited for the RBC count.

D. Region based and edge based segmentation method: WBC's are segmented based on region and edge based method. Region based segmentation calculates the cells in the whole area of the image whereas the edge are identified with the help of edge based segmentation method.

3. BLOCK DIAGRAM:



METHODOLOGY:

Input image is given from the microscope and the output is displayed on the app layout designed.

Algorithm

Step 1: Image acquisition from the blood sample of a person through ultra scope.

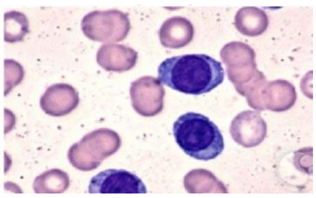


Figure: 3 Input image

Figure: 4 Ultra scope

Step 2: Preprocessing is done in Mat lab with the code generated. The identified preprocessing methods are RGB to Gray scale, Histogram, and Binarizing.

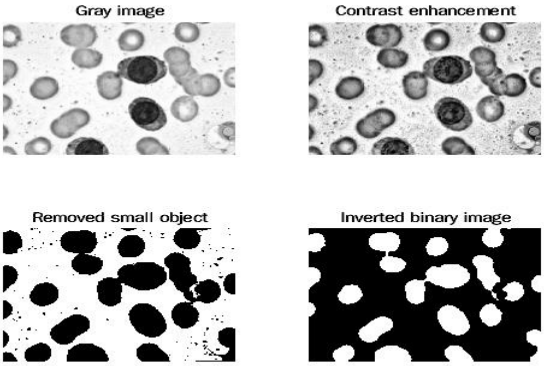


Figure: 5 Preprocessed image

Step 3: Segmentation of WBC and counting of the WBC. The segmentation process of the blood sample is segmented using the size and shape.

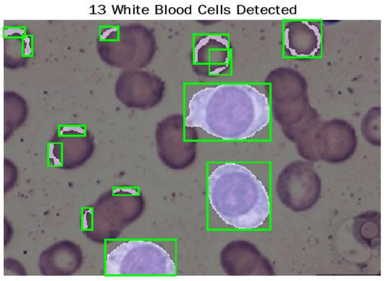


Figure: 6 Segmented WBC image

Step 4: Segmentation of RBC and counting of the RBC. The segmentation of RBC is also segmented by their size and shape.

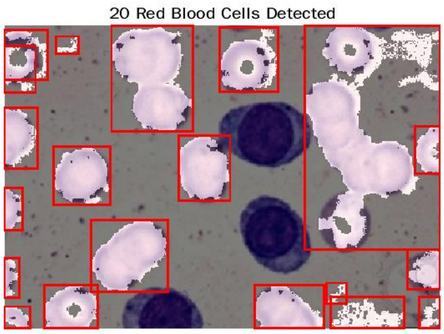
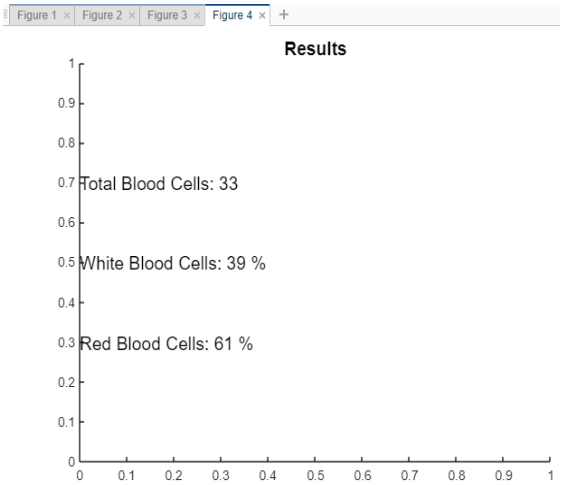


Figure: 7 Segmented RBC image

Step 5: The segmentation of both RBC's and WBC's by region based & edge based segmentation.

Step 6: Circular Hough transform method to count overlapped cells.



RESULT:

S.NO	SAMPLE	TOTAL COUNT	RBC %	WBC %
1.	Sample 1	33	61	39
2.	Sample 2	67	62	45
3.	Sample 3	46	50	42
4.	Sample 4	90	66	54
5.	Sample 5	76	65	30
6.	Sample 6	84	70	43
7.	Sample 7	64	76	45
8.	Sample 8	56	45	30
9.	Sample 9	92	88	76
10.	Sample 10	99	79	65

Table: 1 Result of samples obtained

4. CONCLUSION:

This research proposes a step-by-step automated approach for counting blood cells. With an accuracy of nearly 90%, the proposed method is proven to be more efficient. The offered data sample has been determined to be more effective on the algorithm utilized, and the image processing tool box in MATLAB is extremely simple and straightforward to read images of blood cells. As a result, the technology is simple enough to be used in home-based identification devices. The proposed solution may require the development of an embedded system and the creation of a distinct app in the future. The cost of blood test is very high and it takes time for the results but in this method the results are instantaneous.

REFERENCE:

1. Akshaya P. Sahastrabuddhe, “Counting of RBC and WBC using Image Processing: A Review”, International Journal of Research in Engineering and Technology (IJRET), Volume: 05, pp. 356-360, 2016.
2. Gulpreet Kaur Chadha, Aakarsh Srivastava, Abhilasha Singh, Ritu Gupta, Deepanshi Singla, An Automated Method for Counting Red Blood Cells using Image Processing, Procedia Computer Science, Volume 167, 2020.
3. Alam MM, Islam MT. Machine learning approach of automatic identification and counting of blood cells. Health Techno Lett. 2019;6(4):103-108. Published 2019 Jul 17. doi:10.1049/htl.2018.5098
4. J. Song, L. Xiao and Z. Lian, "Contour-Seed Pairs Learning-Based Framework for Simultaneously Detecting and Segmenting Various Overlapping Cells/Nuclei in Microscopy Images," in IEEE Transactions on Image Processing, vol. 27, no. 12, pp. 5759-5774, Dec. 2018, doi: 10.1109/TIP.2018.2857001.
5. Tajkia Saima Chy, Mohammad Anisur Rahaman, “Automatic Sickle Cell Anemia Detection using Image Processing Technique”, International Conference on Advancement in Electrical and Electronic Engineering, pp. 1-4, 2018.
6. V. D. Dvanesh, P. S. Lakshmi, K. Reddy and A. S. Vasavi, "Blood Cell Count using Digital Image Processing," 2018 International Conference on Current Trends towards Converging Technologies (ICCTCT), 2018, pp. 1-7, doi: 10.1109/ICCTCT.2018.8550999.