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Automated Detection and Counting of Red Blood Cell using Image Processing Techniques.

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Abstract:-**The major issue in clinical laboratory is to produce a precise result for every test especially in the area of Red Blood Cell (RBC) count. Red blood cell (RBC) count in a blood test used to evaluate the overall health and diagnose a wide range of disorders, including anaemia, infection and malaria etc. This blood cell count infers about the disorders against normal healthy blood cell count. The traditional method of manual counting under a microscope yields inaccurate results and put an intolerable amount of stress to medical laboratory technicians. Due to high vulnerability in human error and large time consumption, better and more effective image processing software is needed. As a solution to this problem, this project proposes an image processing technique for counting the number of blood cells.. This paper introduces a cost effective automatic RBC counting method using image analysis technique and specifically aims at improving the results using Hough circle detection. Removing the unnecessary circles created during the Hough Circle Detection will yield more accurate results.**

***Keyword* - Hough transform, MATLAB, Mathematical Morphological Operation, Red blood cells.**

I.INTRODUCTION

Content-based image indexing and retrieval has been an important research area in computer science for the last few decades. Many digital images are captured and stored such as medical images. As a result large image databases are being created and being used in many applications. In this work, the focus of our study is on medical images. A large number of medical images in digital format are generated by hospitals and medical institutions every day.
Consequently, how to make use of this huge amount of images effectively becomes a challenging problem. In the field of biomedicine, because of cell's complex nature, it still remains a challenging task to segment cells from its background and count them automatically. Among all of the body's tissues, blood is unique due to its existence as the only fluid tissue. A blood cell can be any type of cell normally found in blood which falls into four categories which are red blood cell (RBC), white blood cell (WBC), platelet and plasma. The differences between these groups lie on the texture, color, size and morphology of nucleus and cytoplasm. In blood smear, number of red cells is many more than white blood cells. For example an image may contain up to 100 red cells and only 1 to 3 white cells. Platelets are small particles and are not clinically important. Blood cells form in the bone marrow, the soft material. in the centre of most bones. Leukocytes or WBC are cells involved in defending the body against infective organisms and foreign substances. Leukocytes cells containing granules are called granulocytes (composed by neutrophil,basophil, eosiphil). Cells without granules are called a granulocytes (lymphocyte and monocyte) .These cells provide major defence against infections in organisms and their specific concentrations can help specialists to discriminate the presence or the absence of very important families of pathologies. When infection occurs, the production of WBCs increases. Abnormal high or low counts may indicate the presence of many form of disease, since blood counts are amongst the most commonly performed blood test in medicine. Current research is doing on blood counting application in the image segmentation. It is an implementation of automated counting for red blood cell which manually done by haemocytometer by using counting chamber. Red blood cells have their role in the body system and the counting result is important to determine the capability or deficiency of the body system. In short, any abnormal reading of RBC can give a sign of infection or disease. For example low count of red blood cell can be a sign of malaria.

II. PRE-PROCESSING

A. *Noise removal*

This is a pre-process of an image sequence before feeding into the segmentation process. To design a reliable system that maybe used under different conditions such as different blood staining techniques, types of chemical materials used, microscope types, illumination conditions, human errors, etc., a pre-processing step is required. Some Type of Noise Found in Image Processing are Salt and pepper noise which is random occurrences of both black and white intensity values, Impulse noise which is a random occurrences of white intensity values, Gaussian noise which is impulse noise but its intensity After observing various sample images it was found that median filter would be the best noise removal filter.

B. *Conversion to gray scale*

The purpose of pre-processing is to remove unwanted objects and noise from the image to facilitate image segmentation into meaningful regions. The output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard image-processing techniques to it.

•Load image is converted into the Gray Scale Image.

•The next and important step in image segmentation is to extract meaningful regions, or in other words, distinguish objects from background.

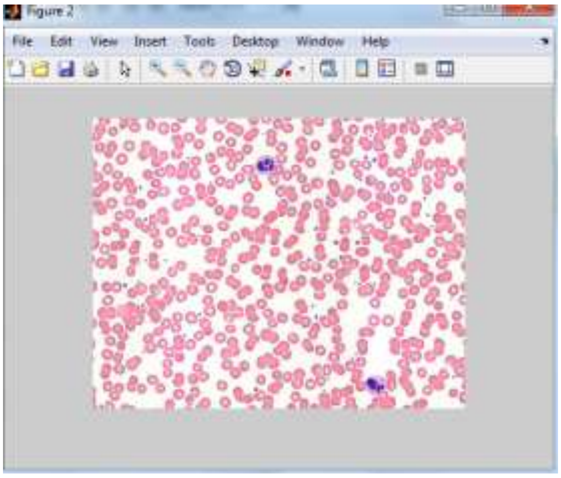


Fig 1 Original image

III. SEGMENTATION

The image needs to be segmented so that when circle detection algorithm is applied image is free of white blood cells. The method used to eliminate white blood cell is by suppressing the Green and Blue component of the image. The stained image of blood smear has white blood cells and platelets stained as blue so the red component when extracted exposes the RBC thereby eliminating the unnecessary components.

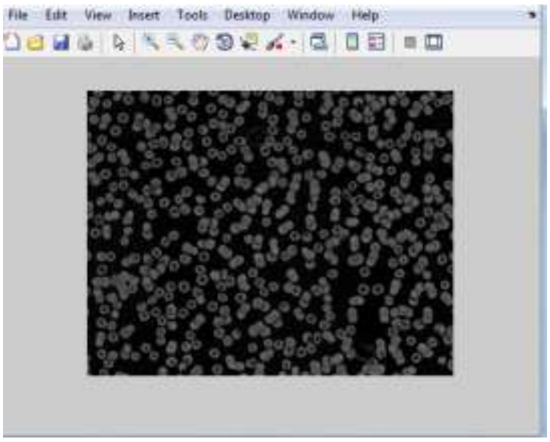


Fig 2. White blood cells eliminated

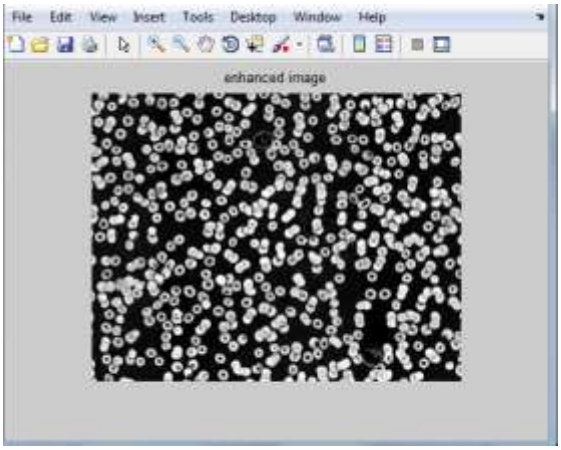


Fig 3

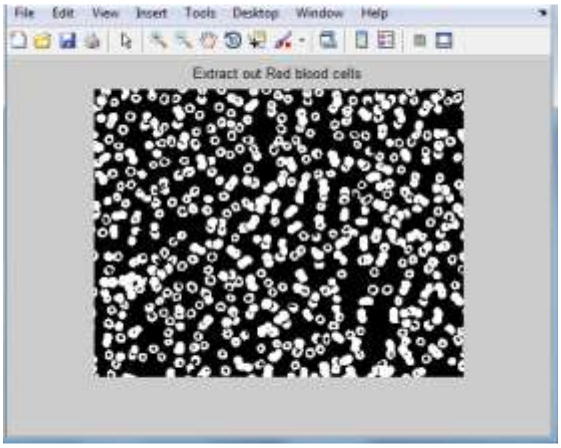


Fig 4

IV. CIRCLE DETECTION USING HOUGH TRANSFORMATION METHOD

The Hough transform is a feature extraction technique used in image analysis, computer vision, and digital image processing. The purpose of the technique is to find imperfect instances of objects within a certain class of shapes by a voting procedure. This voting procedure is carried out in a parameter space, from which object candidates are obtained as local maxima in also called accumulator space that is explicitly constructed by the algorithm for computing the Hough transform.

Circle Detection Process-The process of identifying possible circular objects in Hough space is relatively simple,

- First we create our accumulator space which is made up of a cell for each pixel, initially each of these will be set to 0.
- For each (edge point in image(i, j)): Increment all cells which according to the equation of a circle could be the center of a circle, these cells are represented by the letter 'a' in the equation.

$$(i-a)^2+(j-b)^2=r^2$$

- For all possible value of a found in the previous step, find all possible values of b which satisfy the equation.
- Search for the local maxima cells, these are any cells whose value is greater than every other cell in it's neighbourhood. These cells are the one with the highest probability of being the location of the circle(s) we are trying to locate. Note that in most problems we will know the radius of the circle we are trying to locate beforehand, however if this is not the case we can use a 3 dimensional accumulator space, this is much more computationally expensive. This method can also detect circles that are partially outside of the accumulator space if enough of its area is still present within it. The Hough transform can be used to determine the parameters of a circle when a number of points that fall on the perimeter are known. A circle with radius R and center (a, b) can be described with the parametric equations.

$$x=a+R\cos\theta$$

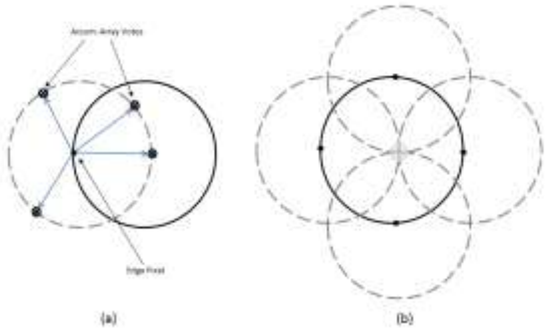
$$y=b+R\sin\theta$$

When the angle sweeps through the full 360 degree range the points (x, y) trace the perimeter of a circle. If an image contains many points, some of which fall on perimeters of circles, then the job of the search program is to nd parameter triplets (a, b, R) to describe each circle. The fact that the parameter space is 3D makes a direct implementation of the Hough technique more expensive in computer memory and time. If the circles in an image are of known radius R, then the search can be reduced to 2D.Theobjective is to nd the (a, b) coordinates of the centers.

$$x=a+R\cos\theta$$

$$y=b+R\sin\theta$$

The locus of (a, b) points in the parameter space fall on a circle of radius R centered at (x, y).The true center point will be common to all parameter circles, and can be found with a accumulation array.



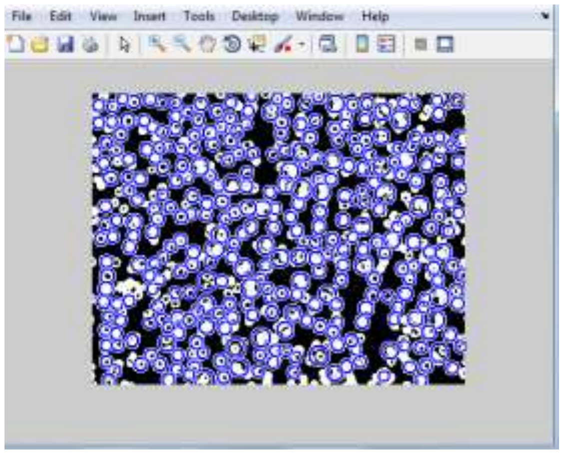


Fig 5

V. REMOVE OVERLAPING CIRCLE

The circular Hough transformation detects some unnecessary circles due to overlapping therefore removing one of the overlapping circles and then taking average of the count of both the methods provides very accurate results. The whole process is fast and consumes nominal CPU cycle. The aim of removing one of the overlap circles and then taking average is to reduce the effect of extra circle counting when Hough circle detection method is applied. The circle overlapping limit is set to 4 pixels if two circles overlapping for more than 4 pixels one of the circle is removed. The remove overlap increases the accuracy of counting circles using the hough circle detection.

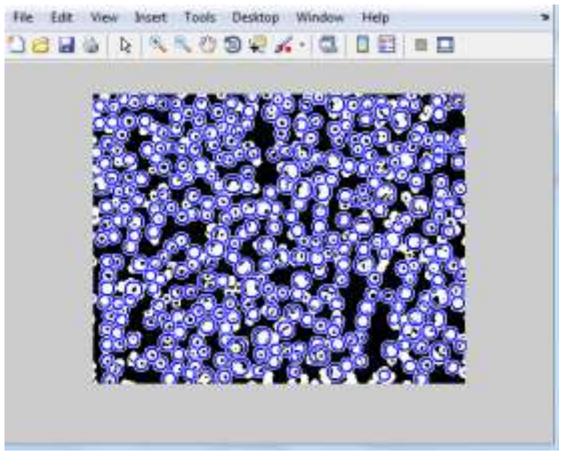


Fig 6

VI RESULTS

A case study of images analysed is presented in table 1. The images captured with an optical laboratory microscope coupled with a Canon Power Shot G5 camera. The overall accuracy is 94.64% the images were of JPEG, PNG format the dataset consists of 75 photos 5 pictures in a set.

Manual Count	Automated Count	% Accuracy
341	324	95.01
317	350	90.57
247	239	96.76

213	207	97.18
350	311	88.85
249	218	91.2
367	328	89.37
119	108	90.75
Total		
2203	2085	94.64

Table 1

VIII.CONCLUSION

A novel approach to blood cell identification, based on simulating a human expert's "look" and "identify", has been introduced here. The "look" effect is approximated via global pattern averaging. When we, humans, have a quick "look" at a familiar object (blood cell types are familiar to a human expert), we do not observe the detailed features but rather a general global impression of the object. This in our hypothesis can be applied to identifying blood cells which usually have irregular shapes, different sizes and colours. The "identify" effect is simulated by training a simple but efficient neural network. The ability of the trained neural network to identify blood cells, despite the irregular non-uniform shapes, is due to training the network using feature approximations or "fuzzy" feature vectors rather than using "crisp" feature vectors. The averaged patterns are true representations of a cell image regardless of its size or orientation. The system presented in this paper was implemented using 360 single-cell images of the three major blood types (red, white and platelets). The 360 images represented 90 different blood cells; each rotated by 90°, thus providing four different orientation for each cell. The images of the rotated cells were only used for testing the trained neural network, and to demonstrate the proposed system's rotational invariance. Here the multilevel perception model used, gives the 81% accuracy. It extracts the RBC's, Sickled Cells; WBC's as well as overlapped cells. The system in a robust manner so that it is unaffected by the exceptional conditions and achieved high percentages of sensitivity, specificity, positive prediction and negative prediction values. And the extraction of red blood cells achieves a reliable performance and the actual classification of infected cells. This work aimed to study the possibility of red blood cells counting. Furthermore, study of the collapsed red blood cells should be done in order to get more accuracy. Results show that the automatic red blood cell extraction and counting start from image processing then single blood cell extracted and finally separating red blood cell offers 74% accuracy or better. Authors believe that the classifier (multi layer perceptron neural networks) is suitable for the RBCs counting application. Higher accuracy can be achieved when the number of sample training images is increased.

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