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Identification of Sickle cells from Microscopic Blood Smear Image Using Image Processing

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ABSTRACT
Blood is a connective tissue in fluid form. Blood cell counting gives vital information about a patient's health. It is used to evaluate and diagnose diseases such as anaemia, polycythemia, leukemia, thrombocytosis thrombocytopenia, identification of sickle cells etc. It indirectly measures the oxygen carrying capacity of blood. There are many blood cell counting methods. The oldest is the manual counting which is still considered as the "gold standard" method for counting blood cells. But this method is subjective and the result depends on the technician. Other method for blood cell counting is by using an automatic hematology analyser. This method gives an accurate blood cell count but the cost of the machine is very high also it cannot identify sickle cells. This paper presents a simple method to count the red blood cells and identify sickle cells using Circular Hough Transform an Image processing technique.
***Keywords**: RBC, Hough Transform, anemia, hematology, CHT*

INTRODUCTION

Blood is considered as the fluid of life, growth and health. It carries oxygen from lungs to all parts of the body and carbon di oxide back to the lungs. It carries nutritive substances from digestive systems and hormones from endocrine gland to the tissues. It also protects the body against diseases and gets rid of waste materials by transporting them to excretory organs like kidneys. Blood is composed of blood cells suspended in a liquid portion called plasma. The three types of cells present in the blood are the Red blood cells (erythrocytes), White blood cells (leucocytes) and Platelets (thrombocytes). Red blood cells do not have any nucleus. It is red in colour due to the presence of an iron containing protein called the haemoglobin. RBCs are larger in number compared to the other two types of blood cells. RBCs are biconcave in shape with sunken centre and thick edges. The normal RBC count ranges between 4 and 5.5 million/cu mm of blood. In adult males, it is 5 million/cu mm and in adult females, it is 4.5 million/cu mm. Anemia is a disease characterized by decrease in the number of red blood cells or decreased haemoglobin content in the blood. This reduction is mainly due to decreased production of RBC, increased destruction of RBC or excess loss of blood from the body. Anemia is caused either due to inherited disorders or environmental influences such as nutritional problem, infection or exposure to drugs or toxins. Sickle cells are red blood cells that are crescent shaped. Haemoglobin S is abnormal haemoglobin that causes the sickle cell anaemia. If the haemoglobin S is inherited from both the parents, the offspring is said to have sickle cell anaemia. The normal red blood cells are shown in

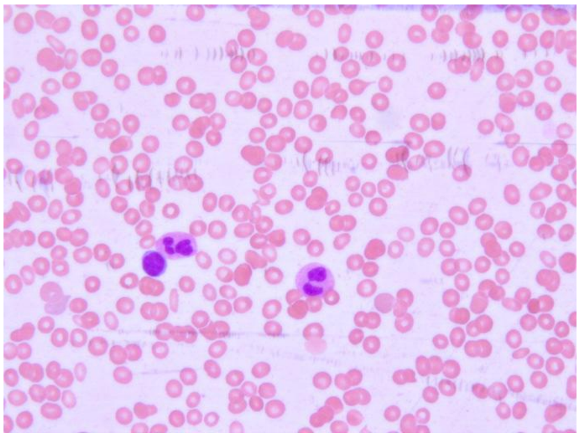

Fig 1. Normal blood cell image

Figure below

The sickle cells can be seen in the figure 2.

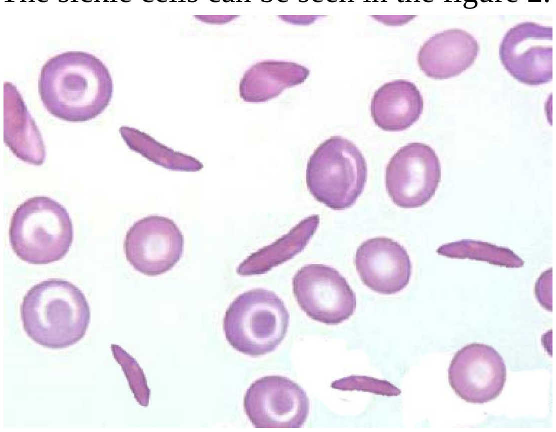

Fig 2. Sickle cell image

EXISTING METHODS

The methods commonly used to count the red blood cells and to identify the sickle cells are given as follows.

A. *Manual counting*

Most often, the counting of cells in a patient's blood is done manually by viewing a slide prepared with patient's blood under a microscope. The advantage is that it is relatively straight forward and does not need expensive instruments. The disadvantage of this technique is that it is tedious and is more prone to errors. It makes the technician very tedious. Technicians have high risk of developing eyestrain. For example, if the technician loses concentration, the counting may need to start from the beginning. It also needs the dilution of the blood sample to avoid sticking together of the cells and reduce overlapping. The amount of dilution needs to be precise for consistent results. It does not accurately count the overlapped cells.

B. *Electrical resistance*

Cells can be counted by their electrical resistance or they conduct almost no electricity. A coulter counter is an appliance that can count the cells as well as measure their volume. In a coulter counter, the cells are swimming in a solution that conducts electricity are sucked one by one in to a tiny gap. Two electrodes that conduct electricity are connected to the two ends of the gap. When no cell is in the gap, electricity flows through the electrodes. For applications, that require counting of large numbers and cell sizes, this method is used.

Most of the commercially available haematology analysers work on this principle. The major disadvantage is the cost of the machine. Also it cannot count overlapped cells.

All these methods do not have an automatic mechanism to identify sickle cells.

PROPOSED METHOD

This paper proposes a method to count the red blood cells using microscopic blood smear images. The blood cell images are taken from a camera attached to a microscope. The software used for counting and identifying the blood cell is mat lab. This paper proposes a Circular Hough Transform technique to detect the red blood cells and a simple counting algorithm for counting the number of cells.

Since the red blood cells are circular in shape, the CHT can be applied to detect the red blood cells also. This function has the ability to detect the overlapped cells also. The first step in the method involves converting the colour image in to gray scale image. The gray scale image retains only the intensity information. The contrast of the image is then adjusted by altering its histogram. The contrast adjusted image is then thresholded to segment the object and the background. Circular Hough Transform is applied to the thresholded image. A simple counting algorithm can be used to count the number of red blood cells. In order to identify the sickle cells form factor is calculated. Form factor is also known as Heywood's Circulatory Parameter. It is calculated by the below given formula,

Form factor=4* pi * area/ (perimeter* perimeter)

The form factor varies with the shape of the object. The form factor value is equal to 1 for a perfect circle, for all other non circular objects this value varies. If the object is a red blood cell, the form factor value will be 1. If it is a sickle cell, the value will be less than 1.

The block diagram for the proposed method is given below.

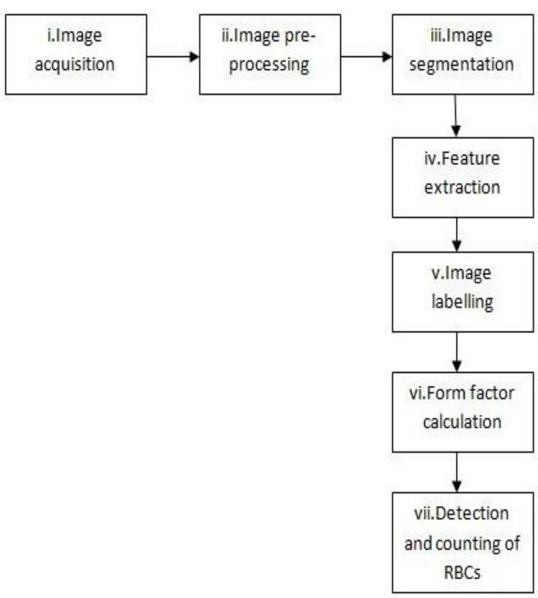

Fig 3. Block diagram of the proposed method

METHODOLOGY

A. *IMAGE ACQUISITION*

The images used for counting and identifying normal and sickle cells must be of high magnification. The images are taken on an improved haemocytometer counting chamber and it is captured on a digital microscope of 1000 X magnification. The image is then processes using different image processing techniques. The input image is shown in the figure below.

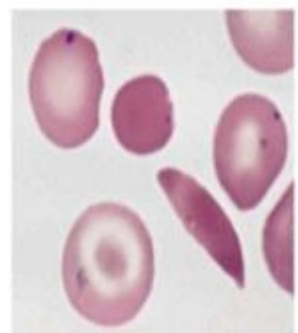

Fig 4. Input image

In the first step the input image is imported in to matlab.

B. *IMAGE ENHANCEMENT*

The imported image has to be enhanced for better segmentation. For this purpose the input image has to be converted in to gray scale image. Now the image contains only the intensity information.

C. *CONTRAST ADJUSTMENT*

The image is then contrast adjusted by altering its histogram. This is done in order to adjust the contrast of the image to see clearly the object and the background.

D. *IMAGE SEGMENTATION*

Image segmentation is done in order to separate image from its background. In this step we select only the area of interest in the image. Here it is the red blood cells which are circular in shape. The red blood cells are counted using the circular hough transform, so much of the segmentation is not needed because the algorithm searches only for the circular objects in the image.

E. FEATURE EXTRACTION

The circular hough transform is then applied to the segmented image. The matlab function imfind circles searches for blood cell in the image and detects them. The radius of the circles can be found out using the imdistline function. This step gives the count of the blood cells in the image.

The result of the above steps is given in figure below.

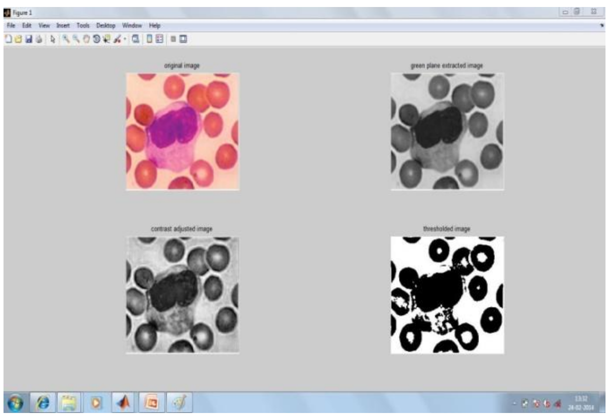

Fig 5 (a)original image (b)gray scale image (c)contrast adjusted image (d) binary image

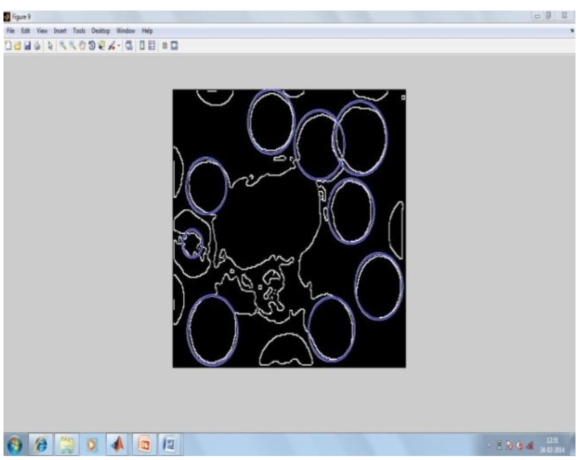

Fig 6. CHT applied image

F. FORM FACTOR CALCULATION

For calculating the form factor the image has to be labelled. Then the form factor is calculated for the labelled image.

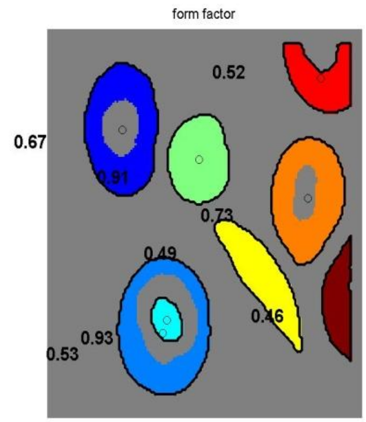

Fig 7. Form factor calculated image

CONCLUSIONS AND FUTURE SCOPE

This paper proposes a simple algorithm to detect, count and identify the normal and abnormal red blood cells like sickle cells in an image using image processing techniques like Circular Hough Transform and Form Factor calculation. A form factor threshold is then fixed. If the form factor ranges from 0.5 to 1, the blood cells are normal, otherwise abnormal. This method of red blood cell and sickle cell detection did not address half cell counting. This limited the accuracy. The accuracy was found to be 91%. In future, the project can be extended to finding half cells and increasing the accuracy.

REFERENCES

1. Pearl. P. Guan , Hong Yan, Blood Cell Image Segmentation Based On The Hough Transform And Fuzzy Curve Tracing, Proceedings of the 2011 International Conference on Machine Learning and Cybernetics, Guilin, 10-13 July, 2011, pp 1696-1701.

2. Guitao Cao, Cai Zhong, Ling Li, Jun Dong, Detection of Red Blood Cell in Urine Micrograph, Proceedings of the 2009 International Conference on Bioinformatics and Biomedical Engineering, Beijing, 11-13 June, 2009, pp 1-4 .
3. Venkatalakshmi.B, Thilagavathi.K, Automatic Red Blood Cell Counting Using Hough Transform, Proceedings of 2013 IEEE Conference on Information and Communication Technologies (ICT 2013), Jeju Island, 11-12 April 2013, pp 267-271.
4. S.Kareem, R.C.S Morling and I.Kale, A Novel Method to Count the Red Blood Cells in Thin Blood Films", International symposium on circuits and systems, IEEE 2011,Rio de Jenerio, 15-18 May 2011, pp 1021-1024.
5. Heidi Berge, Dale Taylor, Sriram Krishnan, Tania S. Douglas, IMPROVED RED BLOOD CELL COUNTING IN THIN BLOOD SMEARS, 2011 IEEE symposium on Biomedical Imaging, Chicago IL, March 30-April 2, 2011, pp 204-207.
6. J. M. Sharif, M. F. Miswan, M. A. Ngadi, Md Sah Hj Salam, Muhammad Mahadi bin Abdul Jamil, Red Blood Cell Segmentation Using Masking and Watershed Algorithm: A Preliminary Study, 2012 International Conference on Biomedical Engineering (ICoBE),27-28 February 2012,Penang, pp 258-262
7. Rongtai Cai, Qingxiang Wu, Rui Zhang, Lijuan Fan, Chengmei Ruan, "Red Blood Cell Segmentation Using Active Appearance Model", Proceedings of 11th International Conference on Signal Processing (ICSP), Beijing, 21-25 oct .2012, vol 3, pp 1641-1644.
8. Ruihu Wang, "Red Blood Cell Classification Through Shape Feature Extraction and PSO-CSVM Classifier Design", Proceedings of 7th International Conference on Advanced Information Management and Systems (ICIPM), Jeju, Nov 29-dec 1 2011, pp 107-111.