

Image Processing Based WBC Counting System for Detecting Leukemia

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Abstract:- The abnormal increase in white blood cells is considered as Leukemia or blood cancer. There are many conventional methods to detect and count the blood cancer cells. But when the accuracy is considered automated method gives far better accepted results than compared to conventional methods. Image processing is one of the widely accepted automated processes for counting the blood cells. The images of the blood samples can be captured using high resolution Webcam connected to light microscope. Further processing can be done using MATLAB based image processing tools. Using this method the counting of cells can be done automatically and accurately.

I. INTRODUCTION

The number of white blood cells in blood should always lie in normal range (~4,500- 11000 per cubic mm in normal adults). But in some rare conditions, the bone marrow dysfunctions and as a result there will be an excess production of WBC's. This type of abnormality is generally termed as cancer in blood or Leukemia. There are different types of blood cancers like acute lymphoblastic leukemia, acute myeloid leukemia and chronic lymphocytic leukemia. There are many conventional methods available and the main disadvantage of this type of counting systems is accuracy (only 65%). Now a day's automated analyzers are used for counting blood cells. The main disadvantage of this type of counting systems though it shows perfect accuracy but it cannot differentiate the abnormal cells from the normal cells. Thus in order to overcome these difficulties a simple and automated method using image processing based on MATLAB tools is used.

II. LITERATURE SURVEY:

The conventional method involves manual counting which is done by well trained professionals. This method may result in certain errors due to some disturbances. If any break occurs at the time of counting of cells, the counting process should be done right from the first step and as a result there is much delay in time. Indiscretion in count may result in wrong interpretations. The expected result done by well trained technician is around ~ 62-67% accuracy in case of conventional manual counting system. Although a hardware digital differentiating cell counter is available as an alternating

that can count the number of blood cells (RBC, WBC) automatically, there is a disadvantage with this method. It can count the number of cells in blood smear but cannot identify or differentiate the abnormal or mutated cells.

If there is any irregularity in the count then there is a chance for wrong interpretations. If there is low count of WBC then it indicates low immune ability to fight against the pathogens. The high count indicates high level of infections, leukemia (blood cancer), stress or damage in tissues. Thus an alternative method is necessary to increase the accuracy in the count. This method should also be able to detect the abnormal cells by considering its morphological characteristics.

Limitations of manual cell counting can be summarized as:

- ◆ The person should be experienced in order to prepare multiple smears in short period.
- ◆ There is chance of unequal distribution of white blood cells as a result of which the large WBC's settle around the edges or scattered throughout the smear, which make it impossible for proper count.
- ◆ If there are small crowded red blood cells then there is a chance to mistaken it as leukocytes.
- ◆ Through manual method it is possible to count only 100-200 cells which is not statistically considered to be reliable.
- ◆ The method is too laborious and also more chances to get biased.

High concentration and attention is required at the time of counting manually is required, because there is a chance of wrong estimation of granulocytes with the

agranulocytes. Hence automated counting system using image processing technique is given utmost importance.

The important step that has been given importance in image processing is segmentation techniques. In 1979 Cseke first used automatic Thresholding method. Later Subrajeet Mohapatra used segmentation, feature extraction for analysis of WBC's. Segmentation is done by using K-means algorithm. Abdul Nasir proposed thresholding technique to correct uneven texture and irregularities. A.N.Aimi used contrast enhancement technique HIS technique to enhance the areas of Leukemia cells. Then Guassian Filters were applied to remove noise in the image.

III. HEMOCYTOMETER:

It is a special thick glass slide. It was first invented by Louis Charles. This slide has deep grooves which are etched by using diamond or laser. These grooves are etched into lines and this as a whole appears like a grid. When a drop of blood sample is placed on the Hemocytometer the red blood cells will settle in the center and white blood cells settle to the edges of the grooves. There are nine squares of equal dimensions and each chamber has 1x1 mm² dimensions which are further divided into 0.0625 mm², 0.05 mm² and 0.04 mm² units. The central part will have finer grooves of 0.0025mm².

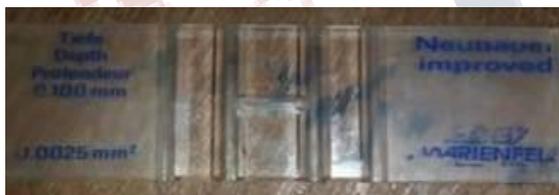


Figure1: Hemocytometer

IV. METHODOLOGY:

This step can be divided into two parts. Initially, clinical procedure is followed and then computation processing is carried out. The clinical procedure is manual process where a 0.5 ml of blood from the patient blood sample that is collected is sucked with the help of WBC pipette. Immediately the blood sample is diluted by sucking WBC diluting fluid up to the mark 11 on the pipette. Now the two mixtures i.e., Blood sample and WBC diluting fluid are mixed thoroughly in the diluting pipette for 2-3 minutes. Placing a cover slip over the grid region of Hemocytometer, small amount of the sample is

introduced into the grooves from the edges where cover slip is placed. Now the slide is kept a side for 20 minutes.

This slide is observed under light microscope using 10x objective lens. This is a manual process. After proper adjustment of the resolution of microscopic lens the eye piece of the microscope is replaced by a high resolution webcam to capture the images of the white blood cells in the sample. Now using the images capture further processing is carried out and this is done by using image processing technique based MATLAB tools.



Figure2: Microscope With Webcam



Figure3: Microscope Connected To Computer

V. OBJECTIVE:

To implement a method to differentiate, to identify the size, shape of the abnormal WBC from the normal. The image processing is done by using MATLAB function regionprops. Histogram Normalization and histogram equalization are applied to enhance the image. The intensity values are taken into account so as to get a clear picture of number of occurrences in the image. Morphological operators are also used for proper processing of image.

VI. PROPOSED WORK:

The images that are captured using high resolution webcam are stored in JPEG format. Now

different functions are applied on these images to get expected output from the processed images.

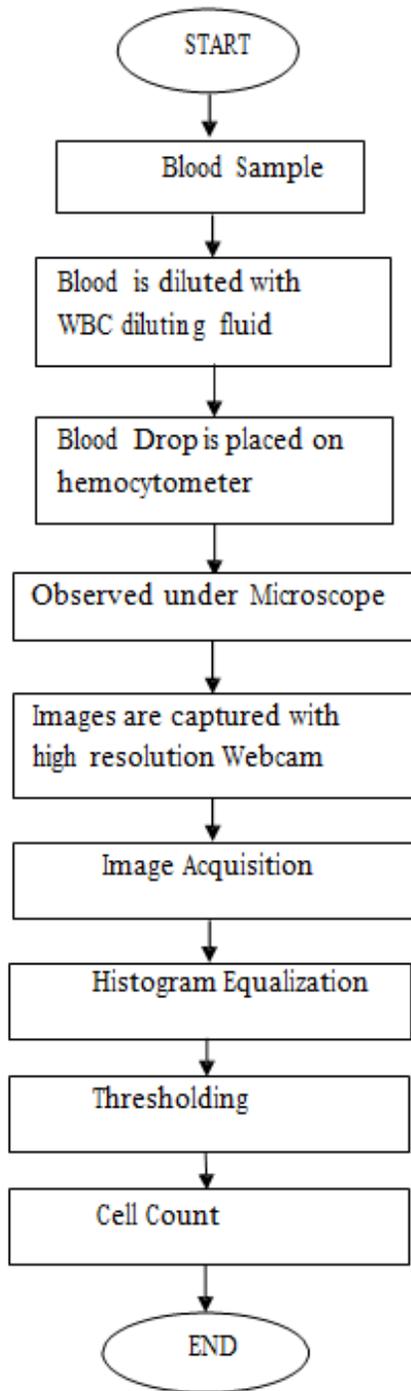


Figure 4: Flowchart representing different steps involved in the process.

VII. SOFTWARE:

The software used for this process is MATLAB 7.8 version. Any MATLAB versions above 6.0 are suitable for performing this type of works. Thresholding operation is the important segmentation method that we applied.

VIII. RESULT:

We have collected around 50 images and carried out different steps of image processing from image acquisition to Image labeling steps to get an accurate result. This method not only results in clear and enhanced images but also count the type of cells which we are interested. The abnormal WBC can be easily identified and also counted with almost 95% accuracy using this method.

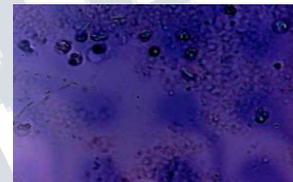


Figure 5: Original image

While capturing the images the main difficulty that we faced was noise. One of the reasons for noise in the images was due to certain amount of illuminations that were released by the cells itself. The very next step we followed after acquisition is image enhancement. For this we converted the RGB image into gray level image.

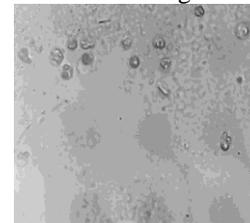


Figure 6: Gray image conversion

In the enhancement step we have given importance to histogram processing. We applied thresholding segmentation process



Figure 7: Image contrast adjustment.

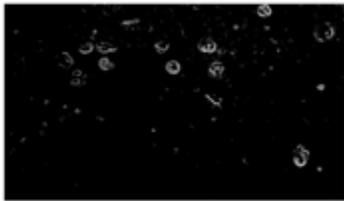


Figure 8: Sharpened Image

We also applied morphological operators in MATLAB tools so as to retain the necessary data in the image.

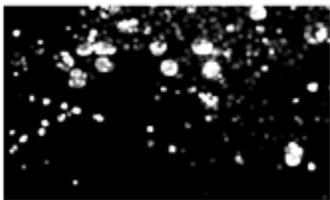


Figure 9: Dilation

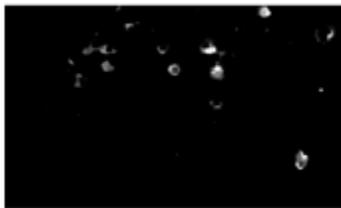


Figure 10: Erosion

Operators like dilation and erosion are applied so as to repair the boundaries of the objects and also for restoring the proper information of the object. A special function Regionprops in Matlab is applied to the images. Using this special function various properties of the objects can be calculated.

The properties that are calculated include finding length of the object and also bounding box of the respective objects. Finally the objects which share similar number of pixels is labeled as one group

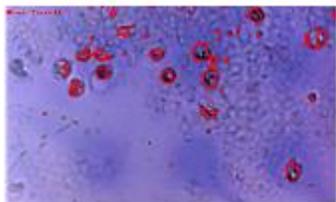


Figure 11: Objects Found

Finally we have labeled the cancer blood cells and total numbers of cancer cells present in the sample are counted. Based on the count we can say that roughly this system helps to get 93% accuracy.

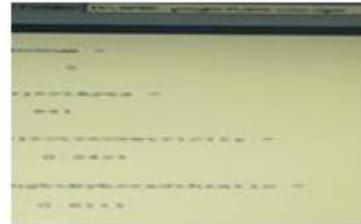


Figure 12: Command Window

IX. CONCLUSION

This method can be applied for both medical diagnosis and also counting the abnormal cells to the normal cells present in the sample. Hence this can be considered as real time application.

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