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ANALYSIS OF LEUKEMIA CELL EXTRACTION AND DETECTION USING WATERSHED TECHNIQUE

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Abstract
There are several diseases such as different types of cancers which can be predicted very finely by Image Processing methods from the Blood Samples. Without treatment, this cancer may be the cause of many deaths. Based on the statistics it is been realized that it is the fifth and sixth cause of death among men and women with this cancer. The main objective is to predict cancer cell in blood samples i.e. acute leukemia. Acute leukemia is a disease of the leukocytes and their precursors. It is characterized by the appearance of immature, abnormal cells in the bone marrow, peripheral blood and frequently in the liver, spleen, lymph nodes, and other parenchymatous organs .The segmentation of the blood smear aspirate by applying the watershed transformation, selection of individual cells, and feature generation on the basis of texture, statistical and geometrical analysis of the cells. The leukemia cells are important to calculate because the leukemia cells show us the various types of infected cells which may cause various types of diseases. To prevent human life from various diseases caused by infected blood cells one should know about his blood cells, the Simulation of blood cells will be done on MALTAB from original blood sample image from Clinical Laboratory.

Introduction
Image Processing
Image processing is a technique for converting an image into digital form and performing operations, in order to get some useful information from it. It is a type of signal dispensation in which input is image, like video frame or photograph and output may be image or characteristics associated with that image.
Necessity of WBC count
A WBC count is a test that measures the number of white blood cells in our body. This test is often included with a complete blood count (CBC). Our blood contains a percentage of each type of white blood cell. Sometimes, our white blood cell count can fall or rise out of the healthy range.So, it is normal for doctors to order a complete blood count and check our WBC count during an annual physical examination. The doctor may recommend a WBC count if somebody complain of persistent body aches, fever, chills, or headaches. A WBC count can detect hidden infections within our body and alert doctors to undiagnosed medical conditions, such as autoimmune diseases, immune deficiencies, and blood disorders. This test also helps doctors to monitor the effectiveness of chemotherapy or radiation treatment in cancer patients.
Water Shed Algorithm
Water Shed Algorithm has an approach, which is explained below:
Any grayscale image can be viewed as a topographic surface where high intensity denotes peaks and hills while low intensity denotes valleys. You start filling every isolated valley (local minima) with different colored water (labels). As the water rises, depending on the peaks (gradients) nearby, water from different valleys, obviously with different colors will start to merge. To avoid that, you build barriers in the locations where water merges. You continue the work of filling water and building barriers until all the peaks are under water. Then the barriers you created give you the segmentation result. This is the “philosophy” behind the watershed.
This approach gives you over segmented result due to noise or any other irregularities in the image. So Open CV implemented a marker-based watershed algorithm where you specify which are all valley points are to be merged and which are not. It is interactive image segmentation. What we do is to give different labels for our object we know. Label the region which we are sure of being the foreground or object with one color (or intensity), label the region which we are sure of being background or non-object with another color and finally the region which we are not sure of anything, label it with 0. That is our marker. Then apply watershed algorithm. Then our marker will be updated with the labels we gave, and the boundaries of objects will have a value of -1.

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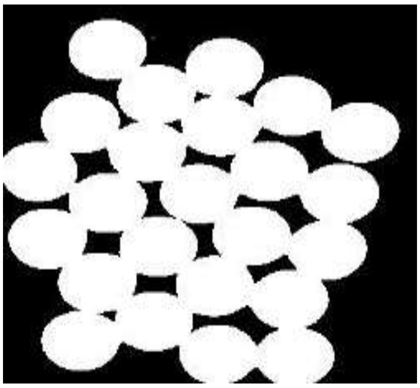
Input image for algorithm

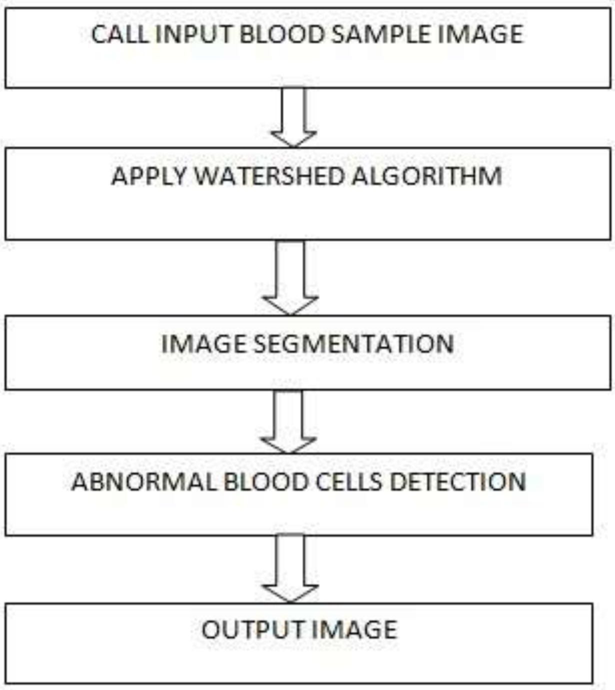


Water Shed Output

Methodology/Planning of work

To implement the objective listed above following methodology will be adopted

Flow chart of proposed algorithm



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Results & Discussion

The work is to counts the number of WBCs in a blood sample using different MATLAB algorithms. The approach named Water Shed algorithm is used. The algorithm detects and extracts only the abnormal blood cells and number of parameters i.e. area, radius, perimeter, form factor, compactness of cells are calculated.

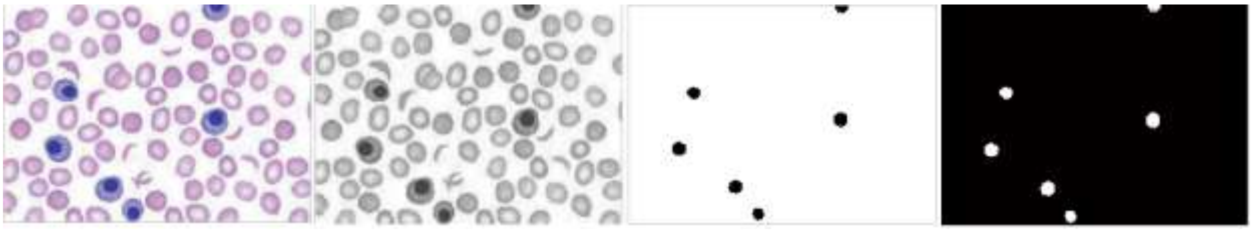

Figure: Input image, Gray scaled conversion, Thresh Holding image & Binary image

In the first input image there are several cells like WBC, RBC and PLATELETS. We have used Watershed Algorithm to extract WBCs from the image, the leukemia cells are highlighted by converting the image into gray scale as shown in second image. In the third image where the cells are extracted, the Thresh holding operation has done. The cells are highlighted by converting the image into black and white

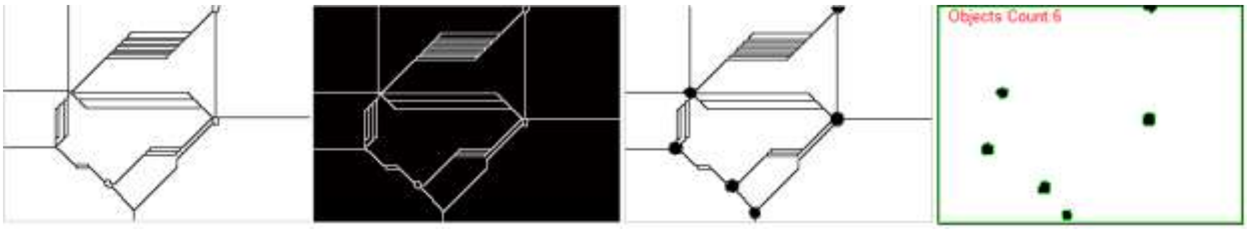

Figure: Watershed Mask, Negative of Watershed, Watershed Segmentation & Final output with counted abnormal cells

In the above figure first image shows the watershed masking on input image. The watershed mask is created to find all the cells in the input image which are infected. The negative of watershed is created in second image. The watershed segmentation is shown in third image, it is a combination of thresh holding image and the watershed mask. In the final output image we have calculated the total number of abnormal cells, the cells extracted by using Watershed algorithm.

We have used some more sample images of blood; the results for some more images are shown below. All the images are firstly executed on MATLAB and than the table below are created for various parameters.

Table: Parameters calculated

Sr. No.	Input image name	Area of cell In pixels	Radius of cell In pixels	Perimeter of cell In pixels	Compactness in Pixels	Form Factor In pixels	Execution Time for Code	Manual Counting	Auto Counting
1	1.png	51.71	51.71	324.92	12.566	1	1.91	9	12
2	2.png	9483	54.94	345.20	12.566	1	2.90	17	16
3	3.png	7577.7	49.11	308.38	12.566	1	1.57	6	6
4	4.png	5840	43.11	270.90	12.566	1	1.58	2	3
5	5.png	3408	32.93	206.94	12.566	1	1.54	5	5

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The table contains the input image names, area of cells, radius of cell and perimeter of cell, the area of a cell, area is calculated by the total area dividing by the number of cells, it will be average area of a cell. The radius is also calculated by using mathematical formulas, perimeter is also shown in the third column. In the above table the form factor and compactness are calculated. It also shows the total time to implement the code. The execution time is calculated because it should be known that how much time our code is taking for generating output. The area is calculated by matlab commands. Rest all parameters are calculated by formulas.

1. Radius is calculated by using mathematical commands.
   Radius = sqrt (area / pi)

2. Perimeter is calculated by the following formula
   Perimeter = 2 * pi * radius

3. Compactness
   Compactness = (perimeter ^ 2) / area

4. Form Factor
   Form Factor = (4 * pi * area) / (perimeter ^ 2)

Conclusion

This research work is based on the detection of the abnormal White Blood Cells in blood sample images. Our implemented code has an approach or algorithm i.e. Water Shed Algorithm. As per approach firstly we have used the algorithm to extract and detect Leukemia cells in blood sample image. We have calculated total number of cells in blood sample image to find the average parameters for a single cell. Secondly we have calculated average area, radius and perimeter for blood cell. Thirdly we calculated Compactness and Form Factor for cells and finally we calculated the time for code execution.

Future scope

In this research work a number of images for research work are taken, calculations related with number of total cells, average area, radius, perimeter of a cell, Compactness, Form Factor & code implementation time are done. For developing an image technique that will become efficient for detecting leukemia cells in blood sample images, one can use some other technique to implement same design with less time. Someone can also calculate some other parameters and can add some GUI design. Moreover some other segmentation techniques like K means clustering, Hough transform algorithm etc can be used to find abnormal cells ie leukemia cells and the results of this research can be compared with them

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