

Automatic Leukemia Detection Using Image Processing Technique

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Abstract: This paper is about the proposal of automated leukemia detection approach. In a manual method trained physician count WBC to detect leukemia from the images taken from the microscope. This manual counting process is time taking and not that much accurate because it completely depends on the physician's skill. To overcome these drawbacks an automated technique of detecting leukemia is developed. This technique involves some filtering techniques and k-mean clustering approach for image preprocessing and segmentation purpose respectively. After that an automated counting algorithm is used to count WBC to detect leukemia. Some features like area, perimeter, mean, centroid, solidity, smoothness, skewness, energy, entropy, homogeneity, standard deviation etc. are extracted and calculated. After that neural network methodology is used to know directly whether the image has cancer effected cell or not. This proposed method has achieved an accuracy of 90%.

Key words: MATLAB code, segmentation, WBC detection, leukemia detection.

I. INTRODUCTION

Leukemia is generated from the bone marrow. It can be cause of death if treatment is not started at right time. A thin material is situated inside each bone which is known as bone marrow shown in the fig. 1. Every human body has mainly three type of blood cells:-RBC(red blood cell),WBC(white blood cell),PLT(platelets).In this paper main point of concern is to detect leukemia. So we are only concentrating on the count of WBC(leucocytes).There are two type of stem cell, myeloid and lymphoid stem cell which are shown in the fig.2.Myeloid stem cell emerges into myeloid blast. This myeloid blast is the reason for generating of RBC(erythrocytes),WBC(leucocytes) and platelets. Lymphoid stem cell also enduces lymphoid blast which will generate only the white blood cell(WBC).Bone marrow produces abnormal white blood cells(WBCs).These abnormal cells should die after some time but in reality they do not die and they become numerous in count. The normal white blood cells are interrupted by those abnormal white blood cells in doing their normal work. And this type of situation is named as disease like 'Leukemia'. Leukemia can be classified into Chronic and Acute leukemia.

Chronic Leukemia:-Abnormal white blood cells perform like normal white blood cells and they will increase gradually.

Acute Leukemia:-Abnormal white blood cells do not perform like normal cells and they will increase rapidly in number.

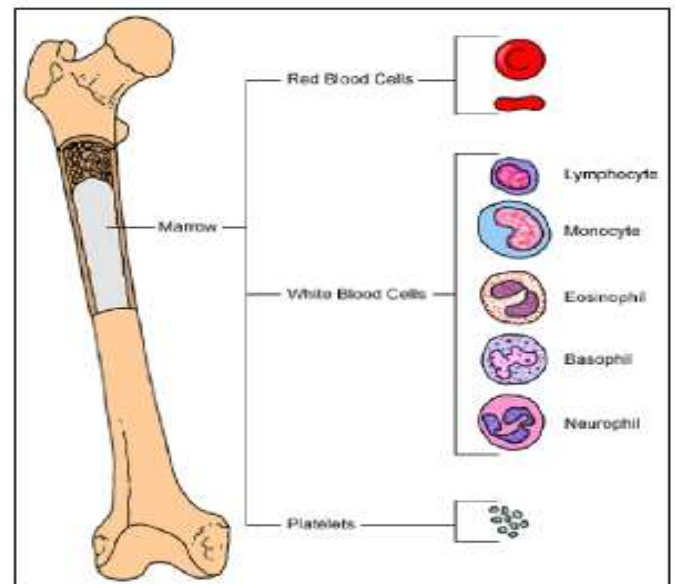


Fig.1

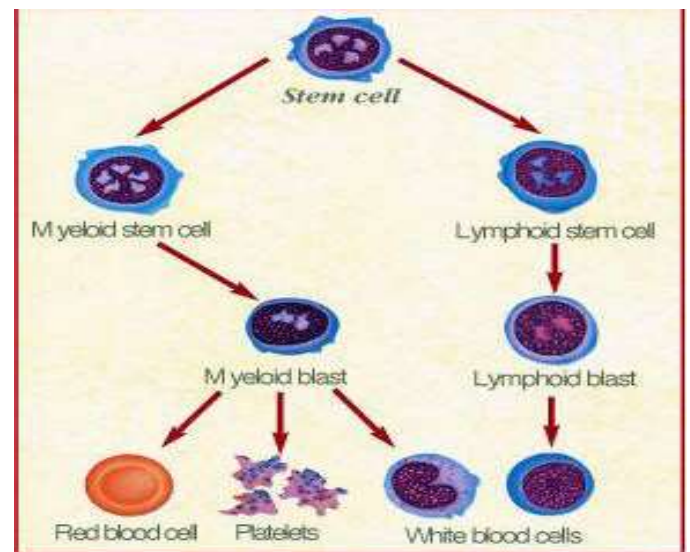


Fig.2

II. PROPOSED METHOD

The Proposed method to detect Leukemia automatically from the microscopic image is shown below.

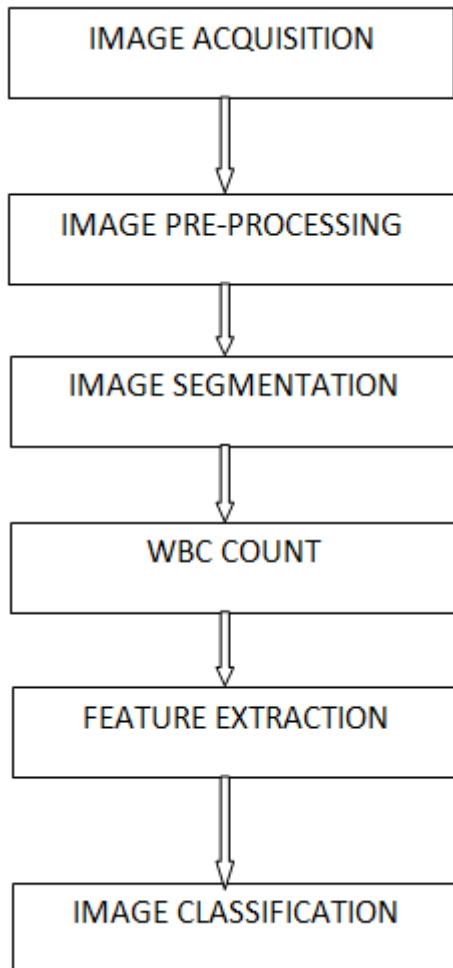


Image Acquisition:

In this part a good quality of images are taken by microscopic setup.

Image Pre-Processing:

The images which are taken may have some noise, blurriness etc. In this part of image processing we are trying to remove those unnecessary things for making the images more suitable for the next step of computational process. Pre-processing techniques usually include enhancing contrast, removing noise, isolating regions etc. The median filtering technique is used here to remove noise. And for removing blurriness from the image wiener filter is used.

Image Segmentation:

This is one of the most important part in the image processing technique. To identify and count white blood cells separation

from the other cells are very much important. Through segmentation separation is done. Segmentation can be done in many way but we are using here the K-means clustering technique for segmentation. Here K-means clustering gives the best result because WBCs are well separated from the other cells in blood sample image. When the images are converted into gray scale images the WBCs are become the darkest region of the images. After that we are applying histogram equalization and Zack algorithm for grouping of white blood cells.

Grouped Cells Identification:

Some blood images have some adjacent cells. It is really difficult to extract some features if the cells are grouped and not well separated. The feature like area are very difficult to extract if the nucleus of the cells are joined together. So our duty is to separate well these cells before studying them further. Some methods are exist to separate those grouped cells. Roundness measurement technique is used here. We are using this technique because we can identify the grouped cells easily by only analyzing the shape of them. Roundness will check whether the shape of the cell is circular or not. Roundness can be extracted by using an equation which is given below:-

$$\text{Roundness} = \frac{4 \times \pi \times \text{area}}{\text{convex_perimeter}^2}$$

The theoretical value of the roundness is 1 for circular objects and less than 1 for non circular objects. But practically after some experiments it is found that 0.9 can be used as threshold value to distinguish single and grouped cells. The objects having the value more than the threshold value are treated as single cells and objects having the value less than the threshold value are treated as grouped cells.

Image Cleaning:

In this part WBCs which are on the edge of the image are removed to get better result.

WBC Count:

In this part WBCs are counted automatically. There some algorithms exist to count WBCs in an automatic way. We are using shape based feature technique algorithm to count WBCs. We get some idea from the Viola-Jones object detection algorithm to detect and count WBCs.

Feature Extraction:

In this part some features are extracted from the processed image. In this phase we are trying to find out the features of the nucleus of the leucocytes(WBCs).Feature extraction is the process of collecting some data from the image so that we can check these values of data with the standard value so that we can differentiate easily that the image has cancerous cells or not. Some of the necessary features which are to be calculated are given below:-

Geometric Features:-

Area,perimeter,centroid,eccentricity,compactness,convexity, concavity,rectangularuty,elongation,solidity etc.

Texture Features:-

energy, entropy, homogeneity, correlation etc.

Statistical Features:-

Mean, variance, standard-deviation, skewness etc.

$$rectangularity = \frac{area}{major\ axis \times minor\ axis}$$

$$elongation = 1 - \frac{major\ axis}{minor\ axis}$$

$$convexity = \frac{perimeter_{convex}}{perimeter}$$

$$compactness = \frac{4 \times \pi \times area}{perimeter^2}$$

$$solidity = \frac{area}{convex\ area}$$

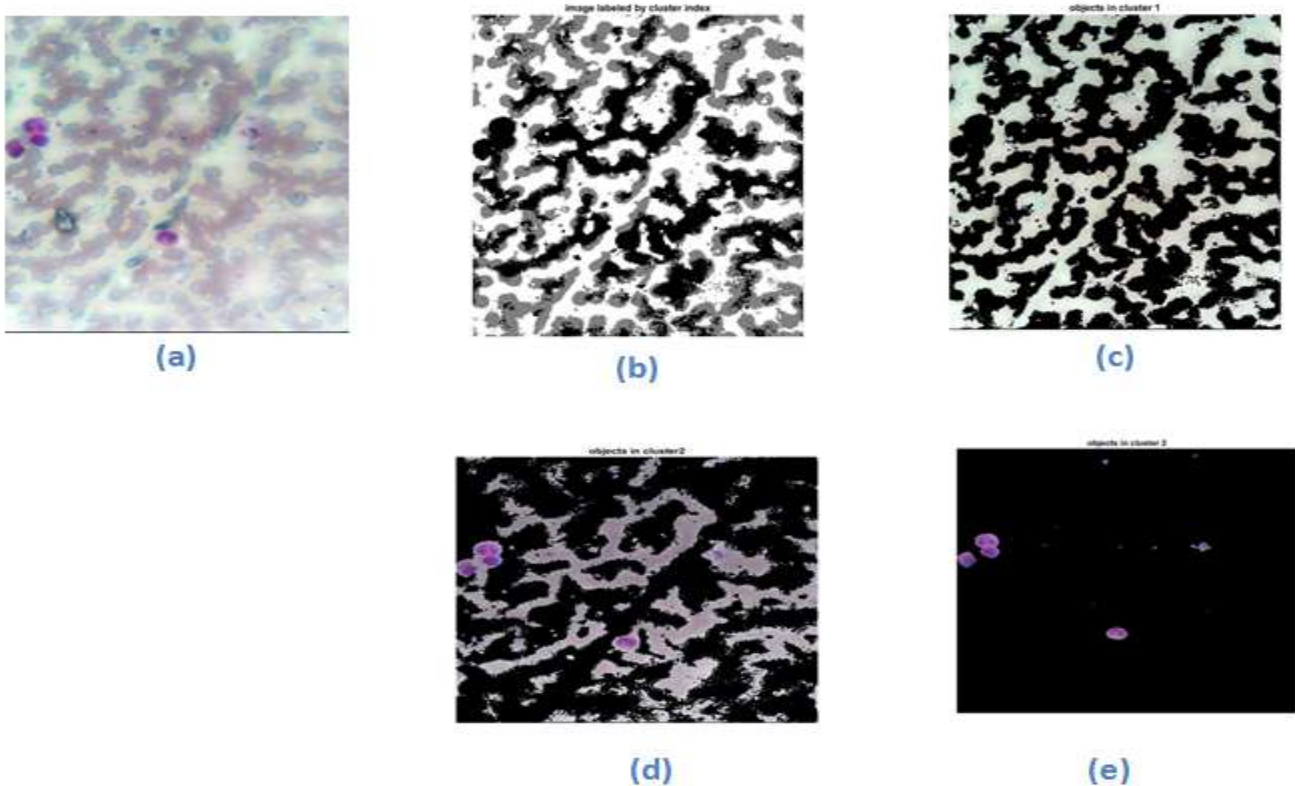
Rectangularity is tells about the bounding box fitness. Convexity is nothing but the difference between the object from its convex object. The ratio of area of an object and area of the circle with same perimeter is called as compactness. The ratio of area and the convex area of each object is named as solidity. Actually solidity is used to remove the object from the image which has irregular boundaries. If the value of solidity is 1 then we can say that the object has regular surface and if the solidity value is less than 1 then the object does not have regular boundaries. But after a lot of experiments we can set the threshold value of solidity as 0.85. So the object in the image having the value less than that is removed.

Image Classification:

All the features are calculated and extracted are listed in a column with their values. We will get a matrix called feature extracted matrix. The image to be tested called as test image. The values of the test image features are checked with the previously calculated values based on the values of the input test image while the SVM classifier will classify that whether the test image has infected cell or not. We are also using PNN(probabilistic neural network) with the extracted feature matrix to know whether the cell is infected or not.

III. EXPERIMENTAL RESULTS

The proposed system gives the below images as result.



The image which is tested in proposed method is called as input blood image shown in the fig(a).After that image pre-processing is done that means noise reduction, contrast enhancement, edge cleaning etc. are done and then convert the image into the gray scale image. After that the proposed system converts the gray image into the cluster index image which is shown in the fig(b).After that k-means clustering algorithm is used to extract three cluster from the image which are background, red blood cell cluster, white blood cell cluster. Background cluster image is shown in the fig(c).Red blood cell cluster image is shown in the fig(d).And the most important one for our study white blood cell cluster is shown in the fig(e).

IMAGE	MANUAL COUNT	AUTOMATIC COUNT	ACCURACY
Image1	4	4	100%
Image2	6	6	100%
Image3	8	7	87.5%
Image4	3	3	100%
Image5	5	5	100%
Image6	4	4	100%
Image7	9	8	88.8%
Image8	11	10	90.9%
Image9	15	12	80%

Table1-The proposed system performance for WBC detection.

Results of 9 images are given here. But we have done observations on lot of images which is nearly about a slide. After a lot of experiments we have achieved an accuracy of 94.11%.

IV. CONCLUSION

In this paper the main point of concern is automatic counting of WBCs to detect leukemia automatically from the image which is taken from the microscope. The manual counting

process to detect leukemia is very much time taking and gives inaccurate result also. So to save lives this automated proposed method is very important. Actually in two ways we can detect leukemia. one is by automatic counting and on the other way SVM classifier will tell automatically whether the image has leukemia effected cells or not. For the first one after segmentation counting algorithm is used to count automatically. And for the second one some features are extracted to form a feature matrix to compare with the standard values. We have achieved an accuracy of almost 94.11% using this proposed method of counting.

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