AUTOMATIC DETECTION OF WBC CELLS

Aishwariya Ramakant Karekar[1], Sufola Das Chagas Silva Araujo[2], Dr. Luis Clement Mesquita[3]
[1]Department of Information Technology, Padre Conceição College Of Engineering, Goa, India
[2,3]Department of Computer Engg., Padre Conceição College Of Engineering
Goa, India

Abstract
There are different types of cells in human blood. Pathologist detect these blood cells and diagnose different disease. This paper describes the way in which we can detect these cells in body by using the concept of image processing. The manual way of detecting these cells and diagnosing the disease is very time consuming and chances of making mistakes is more. The main aim of this project is to develop a system were by just giving input of the image we could detect the cells. The methodology used is as follows :- image acquisition, image segmentation, trained images, test images, feature extraction of cells, feature vector dataset , similarity of cells. This will detect the different cells.

Keywords: Red Blood Cells(RBC).White Blood Cells (WBC), Image Segmentation, Feature Extraction.

I. INTRODUCTION

Different diseases found in human blood cell were some can be very harmful and can also cause death of the patient.Detecting these cells can help the phathologist in diagnosing diseases like AIDS,leukemia and blood cancer[15] In order to control such harmful disease many scientist have tried different method for identifying the different cells in human blood [3].Human Blood contains Red Blood Cells (RBC), White Blood Cells (WBC) or Leukocytes and blood platelets[3]. RBC are also called as erythrocytes. These are most common in blood. In human blood there is 20-30 trillion RBC. WBC are fewer in human blood. In human blood there is 4,000-10,000 (µm)WBC[10]. Platelets are smallest cells in our blood. In human blood the size of platelets are 2-3µm in diameter[4]. These cells are detected by the pathologist and diseases are diagnosed. This paper focuses on WBC cells. WBC are the cells of immune system which protect the body from infectious disease and foreign diseases[3].The count of WBC indicates the diseases in human body[16]. The WBC cells are different from other blood cells because of their shape,color and size[3].WBC have five different types based on the shape and color[3]. The five type of WBC are neutrophil, eosinophils, monocytes, basophils and lymphocytes[9]. These five types of WBC are classified in two categories Granulocytes and Agranulocytes. Granulocytes are the cells with several nuclei lobes. Granulocytes have following types of cells Basophils, Eosinophils and Neutrophils. Agranulocytes area cells with no granules. Agranulocytes have following types of cells Monocytes and Lymphocytes. The neutrophil cells contains nucleus divided in two to five lobes. Diameter of neutrophil cells is 10-12(µm).The eosinophil contains nucleus divided in two lobes. Diameter of eosinophil cells is 10-12(µm).The basophil contains nucleus of bi or tri lobed but it is difficult to see these lobes because coarse granules hide it. Diameter of these cells 12-15(µm).The lymphocyte contains one large nucleus which covers entire cytoplasm. Diameter of these cells 7-8(µm) for large and 12-15(µm) small. The monocyte contains one nucleus of kidney shape. Diameter of these cells 15-30(µm).The average percentage of these WBC cells in human body are as follows:- Neutrophil-50-70%,Eosinophil-1-4%,Basophil-1%,Monocyte-6% and Lymphocyte-20-40% [4].The pathologists are detecting these cells manually which is more prone to human errors and time consuming also. Manual detection is more troublesome because

the human eyes have to detect the cells based on shape of the cells. The system proposed in this paper is to detect the different cells. This will give less error prone result within less amount of time. cells in human body are as follows:- Neutrophil-50-70%,Eosinophil-1-4%,Basophil-1%,Monocyte-6% and Lymphocyte-20-40% [4].The pathologists are detecting these cells manually which is more prone to human errors and time consuming also. Manual detection is more troublesome because the human eyes have to detect the cells based on shape of the cells. The system proposed in this paper is to detect the different cells. This will give less error prone result within less amount of time.

II. SYSTEM PROPOSED

The system developed is automated system where it detects the different cells in human blood. This process has different steps. These steps are shown in the following diagram (Figure1). The input to this system is a blood smear image of different cells in blood smear image which has only one cell of any type of WBC cells. The output of the system will be the name of the cell detected and the file path where it is stored.

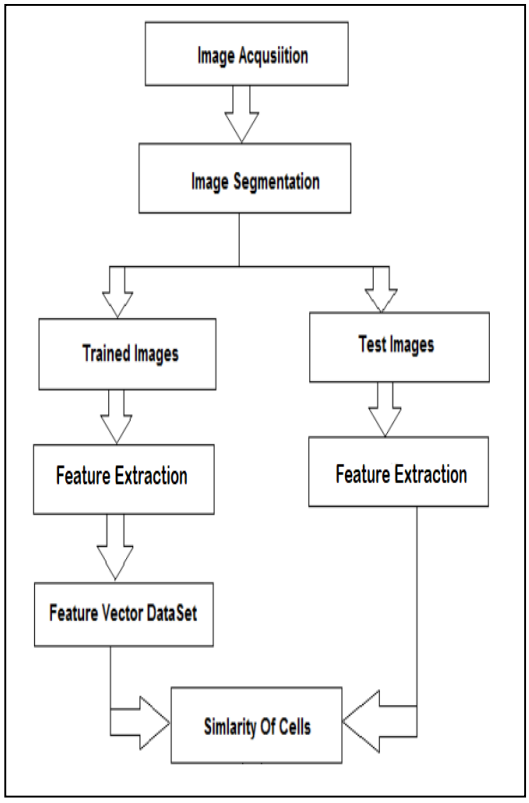

Figure 1:-System Flowchart to detect different WBC cells.

III. METHODOLOGY

The methodology of the proposed system to detect different cells is as follows:-

A. *Image Acquisition*

The images are obtained form the pathology lab. Pathologist prepares the blood smear and places under 100x resolution lens of microscope. Now the camera is placed on the eyepiece of the microscope and the image is obtained. All of these images are stored in *.jpg format in folder.

B. *Image Segmentation*

These images obtained are given as input to segmentation phase. Image segmentation is where we partition image into different segments. The main aim of segmentation is to represent the image in more meaningful way so that it becomes easier to analyse. This system uses image segmentation since we will be referring to different cells in blood smear. Using segmentation we will be separating the image background and the cell so that we could only get the cell nucleus in the foreground of the image[14]. Image segmentation will also help to distinguish between the shapes of cell nucleus. Here the region of interest (nucleus) is set to its original color and background is set to white.

C. *Trained Images*

It is a data set of images which will have only one cell which can be any of the five types of WBC cells. These will be used to create the data set which contains the feature vector of these cells.

D. *Test Images*

It is a data set of images which will have only one cell which can be any of the five types of WBC cell. The Feature vector of these images will be used to compare against the standard feature vector of cells in the feature vector dataset.

E. *Feature Extraction*

This is very important phase of this project. Feature extraction includes morphological operations [1]. The features are based on shape, color and texture feature[13]. It extracts some important information of the object of interest. In this system we are trying to find the shape features of the cell's

nucleus[12]. We are finding the feature vector of the trained image and then that feature vector is compared with the feature vector obtained from the test image which is blood smear which has only one cell of any type of WBC cell. The shape features are obtained by the calculating the moments of each cells. Following are steps to calculate feature vector:-

1) *Dividing the image into regions*
   After segmenting the image the image is divided into regions. This step is needed since it becomes easy to get the region of interest. It also becomes easier to get the area and centroid of the region of interest.
2) *Calculating area of each regions*
   Here we count the number of pixels which satisfies some condition.
3) *Calculate the number of x-coordinate pixels and y coordinate pixels*
   Here we are summing up all the values of x-coordinate pixel and y-coordinate pixel which satisfies some condition.
4) *Calculating x-centroid and y-centroid of each region*
   Here it calculates the x-centroid and y-centroid of each region.
5) *Calculating the x-centroid and y-centroid of entire image*
   Here it calculates the x-centroid and y-centroid of region of interest.
6) *Calculating the feature vector*
   Here we are calculating the feature vector. Feature vector which is a vector of moments.
   Moments:-
   Image moment is average or moment of image pixel's intensities or moment function which is usually has some properties related to image. These properties can be area, centroid and so on. Moments are useful in shape analysis. Zero to third order moments have been used in applications such as shape recognition and orientation[18].

F. *Feature Vector DataSet*

It is the data set which will have the name of the cell, the file path were the cell is stored and the feature vector of the cell.

G. *Similarity Of Cells*

Here we compare the feature vector of the test image with the feature vector of the different WBC cells in the trained data set. To compare the two feature vector we remove the Coefficient of Correlation (CoC) of the two feature vector.

Coefficient of Correlation:-

Correlation is a method for finding similarities between the two measured quantities that is to check whether the two quantities are identical or they are completely uncorrelated or they are completely anti-correlated. Pearson's correlation coefficient is denoted as r . It was developed by Karl Pearson. It is widely used in patter recognition and image processing[2].

Pearson's correlation coefficient is defined as[2]:-

$$r = \frac{\sum_i (x_i - x_{avg})(y_i - y_{avg})}{\sqrt{\sum_i (x_i - x_{avg})^2}\sqrt{\sum_i (y_i - y_{avg})^2}}$$

where:-

x and y are two feature vectors at i^{th} position

x_{avg} and y_{avg} are the average of the two vectors.

If the correlation coefficient value r=1 than the two images are absolutely identical [2].

If the correlation coefficient value r=0 than the two images are completely uncorrelated [2].

If the correlation coefficient value r= -1 than the two images are completely anti-correlated [2].

IV. EXPERIMENTAL RESULTS AND COMPARISONS

In this section we will be displaying the images of the Different cells before and after segmentation.

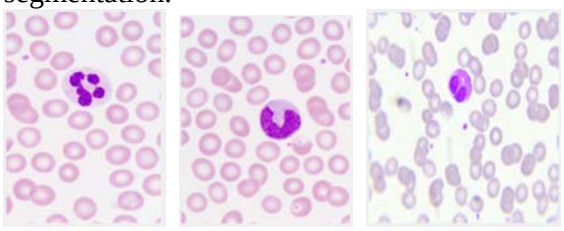

Figure 2(a)

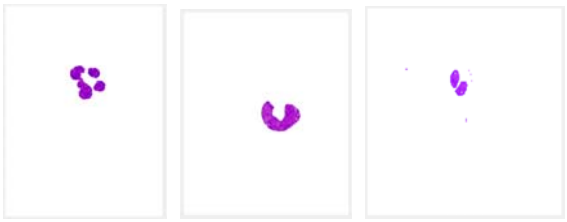

Figure 2(b)

Figure 2(a) are the images before segmentation and Figure 2(b) are the images after segmentation.

The table below shows the result class in which the test falls into. The result of testing is done on different images are shown in table below:-

Result Class	Count of images
True positive	26
False negative	2
False positive	2
True negative	0

Table1:-Result of testing.

V. CONCLUSION

The Automatic Detection of WBC Cell Count is useful for the pathologist for detecting the cells. This system will reduce the errors which can occur during detection of cells manually. This system will also reduce the time for detecting the cell. This system is able to detect the WBC cells. This is done by comparing the feature vector of the test image with the feature vector dataset than the system finds the correlation between the two vectors and based on the similarity value it classifies the cell type. This system would be useful in the pathology lab for fast detection of the cells.

REFERENCES

[1] Amruta Pandit,Shrikrishna Kolhar,Pragati Patil,"Survey on Automatic RBC Detection and Counting",Vol. 4, Issue 1,January 2015.

[2] Avneet Kaur, Lakhwinder Kaur and Savita Gupta," Image Recognition using Coefficient of Correlation and Structural SIMilarity Index in Uncontrolled Environment", International Journal of Computer Applications (0975 – 8887) Volume 59– No.5, December 2012

[3] Anjali Gautam, Priyanka Singh, Balasubramanian Raman, Harvendra Bhadauria," Automatic Classification of Leukocytes using Morphological Features and Naïve Bayes Classifier"

[4] Pramit Ghosh, Debotosh Bhattacharjee ,Mita Nasipuri," Blood smear analyser for white blood cell counting:Ahybrid microscopic image analysing technique". I.S. Jacobs and C.P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G.T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271-350.

[5] Mu-Chun Su,Chun-Yen Cheng,Pa-Chun Wang,"A Neural-Network- Based Approach to white Blood Cell Classification"

[6]K.Pradeep,C.Ganthimathi,K.Harini,N.Diddha,"Detection and Counting of Blood cell in blood smear image."

[7] Mehdi Habibzadeh,Adam Krzyzak,Thomas Fevens,"Comparative study of shape,intensity and texture features and support vector machine for white blood cell classification"

[8] Niranjan Chatap,Sini Shibu,"Analysis of blood samples for counting leukemia cells using Support vector machine and nearest neighbour"

[9] Ahmed S.Negm,Osama A.Hassan,Ahmed H.Kandil."A decision support system for Acute Leukaemia classification based on digital microscopic images"

[10] Syadia Nabilah Mohd Safuan,Dr Mohd Razali Md Tomari,Dr Wan Nurshazwani Wan Zakaria,"White Blood Cell(WBC) Counting Analysis in Blood Smear Images Using Various Color Segmentation Methods"

[11] E.Montseny,P.Sobrevilla,S.Romani," A Fuzzy Approach to white Blood Cells Segmentation in Color Bone Marrow Images"

[12] Howard Lee,Yi-Ping Phoebe Chen,"Cell morphology based classification for red cells in blood smear images"

[13] Neelam Sinha, A.G Ramkrishnan,"Automation of Differential Blood count"

[14] Min Wong,Rong Chu,"A Novel White Detection Method Based On Boundary Support Vectors"

[15]Seyed Hamid Rezatofighi,Hamid Soltanian Zadeh,"Automatic recognition of white blood cells in peripheral blood"

[16] J.Preethi,R.S.Aarthi,"Semiautomatic White Blood Cell Segmentation In Medical Image Analysis Using Neural Networks"

[17]Dr.T.C. Manjunath,"Detection of Shapes of Objects Using Sophisticated Image Processing Techniques".

[18]Mo Dai, Pierre Baylou , Mohamed Najim,"An efficient algorithm for computation of shape moments from run-length codes or chain codes"