

Red Blood Cells Classification using Image Processing

Navin D. Jambhekar

Department of Computer Science

S.S.S.K.R.Innani Mahavidyalaya Karanja (Lad) Dist. Washim (MS)

navin.dj@hotmail.com

ABSTRACT

This paper investigates automated diagnosis of red blood cell's and describes a method to classify the different shapes of red blood cells using the image processing techniques. The shape of red blood cells can be analyzed and their structures can be recognizing with the help of image processing techniques. Visual inspection of microscopic images is the most widely used technique for determination of different shapes of red blood cells and it is a labour-intensive repetitive and time consuming task. To classify the structure of red blood cells, edge detection and segmentation are the two image processing techniques used. The image of red blood cells are captured through the microscope, plotted on the glass slide or recorded from the Scanning electron microscope. An image can be considered as a matrix of light intensity levels. This paper provides the way to classify the different structure of RBC with the help of different methods of image processing.

Keywords: Segmentation, image smoothing, edge detection

INTRODUCTION

An image can be considered as a matrix of light intensity levels that can be manipulated using computer algorithms in MATLAB. Although none of the algorithms developed can be used, as of now, in a real time sense, they provide some insight into the feasibility of imaging processing techniques. For image processing, the analysis must be carried out. Image analysis is concerned with the extraction of measurements, data or information from an image by automatic or semiautomatic methods. Image analysis is distinguished from other types of image processing, such as coding, restoration, and enhancement, in that the ultimate product of an image analysis system is usually

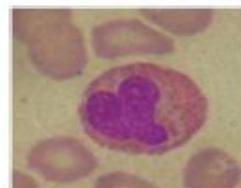
numerical output rather than a picture. Image analysis also diverges from classical pattern recognition in that analysis systems. The shape of red blood cell contributes more to clinical diagnosis with respect to blood diseases. The image processing is carried out with the help of segmentation, edge detection, edge smoothing.

Blood Cells

In humans, mature red blood cells are flexible biconcave disks that lack a cell nucleus and most organelles. 2.4 millions of erythrocytes (RBCs) are produced per second. A healthy blood cell carries oxygen (O_2) to various parts of body. The healthy blood cells is shown in the figure 2.1



Fig. 2.1 A healthy Red Blood Cell



A White Blood Cell

There are three types of cells in normal human blood. The bigger cells-containing the darker material-the nucleus- is a WBC's, the smaller diffuse cells are the platelets and the smaller solid pieces are the RBC's

MATERIALS AND METHODS

To identify and discovering the red blood cells among the other white blood cells and platelets, the segmentation and edge detection techniques are helpful. Before examine the structure of RBCs, the images can be recorded with the help of glass slides and images get captured using microscopes. The images get converted color images to grey level images. Classifying the image by grey-level pixels may reduce and simplify some image processing operations such as edge detection, edge smoothing, feature extraction, image processing and image registration.

Edge Detection

Edges in images are regions with very high contrast in intensity of pixels; detection of edges reduces the amount of data, filters useless information and preserves important structural details (Henkyu Moon 2002). This method is multi-step procedure; it first finds edges by looking for local maxima of the gradient of image. The gradient is calculated using the derivative of a Gaussian filter which smoothes the image in order to reduce noise and unwanted details as well as textures. There are an extremely large number of edge detection operators available, each designed to be sensitive to certain types of edges. Variables involved in the selection of an edge detection operator include Edge orientation, Noise environment and Edge structure. The geometry of the operator determines a characteristic direction in which it is most sensitive to edges. Operators can be optimized to look for horizontal, vertical, or diagonal edges. Edge detection is difficult in noisy images, since both the noise and the edges contain high frequency content. Attempts to reduce the noise result in blurred and distorted edges. Operators used on noisy images are typically larger in scope, so they can average enough data to discount localized noisy pixels. This results in less

accurate localization of the detected edges. However, the majority of different methods may be grouped into two categories:

Gradient based Edge Detection:

The gradient method detects the edges by looking for the maximum and minimum in the first derivative of the image.

Laplacian based Edge Detection:

The Laplacian method searches for zero crossings in the second derivative of the image to find edges. An edge has the one-dimensional shape of a ramp and calculating the derivative of the image can highlight its location.

Feature Extraction

An image feature is a distinguishing primitive characteristic or attribute of an image. Some features are natural in the sense that such features are defined by the visual appearance of an image, while other, artificial features result from specific manipulations of an image [Markiewidz *et al*, 2006]. Natural features include the luminance of a region of pixels and gray scale textural regions. Image amplitude histograms and spatial frequency spectra are examples of artificial features. Image features are of major importance in the isolation of regions of common property within an image and subsequent identification or labeling of such regions.

Image Segmentation

Segmentation of an image entails the division or separation of the image into regions of similar attribute. The most basic attribute for segmentation is image luminance amplitude for a monochrome image and color components for a color image. Image edges and texture are also useful attributes for segmentation. Several generic methods of image segmentation are available. Any one can be used to segment a blood image. The methods include amplitude segmentation method, where image segmentation methods based on the thresholding of luminance or color components of an image.

Histogram

A histogram is one of the simplest methods of analyzing an image. An image histogram maintains a count of the frequency for a given color level. When graphed, a histogram can provide a good representation of the color spread of the image. Histograms can also be used to equalize the image, as well as providing a large number of statistics about it.

Classification using Artificial Neural Network

A *neural network* is a computational structure inspired by the study of biological neural processing. There are many different types of neural networks, from relatively simple to very complex, just as there are many theories on how biological neural processing works. We will begin with a discussion of a *layered feed-forward* type of neural network. A layered feed-forward neural network has *layers*, or subgroups of processing elements. A layer of processing elements makes independent computations on data that it receives and passes the results to another layer. The next layer may in turn make its independent computations and pass on the results to yet another layer. Finally, a subgroup of one or more processing elements determines the output from the network. Each processing element makes its computation based upon a weighted sum of its

inputs. The first layer is the *input layer* and the last the *output layer*. The layers that are placed between the first and the last layers are the *hidden layers*. The processing elements are seen as units that are similar to the neurons in a human brain, and hence, they are referred to as *cells*, *neuromimes*, or *artificial neurons*. A *threshold function* is sometimes used to qualify the output of a neuron in the output layer. A layered feed-forward neural network has *layers*, or subgroups of processing elements (Zheng *et al*, 2004; Kumar 2005). A layer of processing elements makes independent computations on data that it receives and passes the results to another layer. The next layer may in turn make its independent computations and pass on the results to yet another layer. Finally, a subgroup of one or more processing elements determines the output from the network. Each processing element makes its computation based upon a weighted sum of its inputs. The first layer is the *input layer* and the last the *output layer*. The layers that are placed between the first and the last layers are the *hidden layers*. The processing elements are seen as units that are similar to the neurons in a human brain, and hence, they are referred to as *cells*, *neuromimes*, or *artificial neurons*. A *threshold function* is sometimes used to qualify the output of a neuron in the output layer.

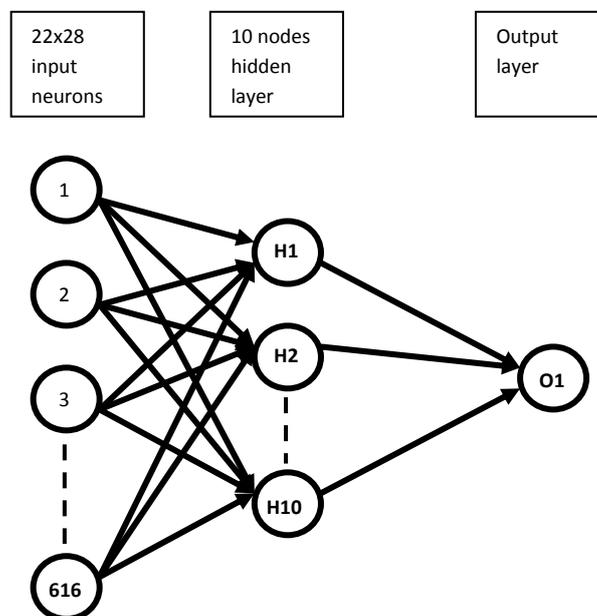


Fig: Structure of Feed-Forward network for problem classification.

Neural network consists of three fully connected layers as shown in following figure. The image analyzed is 22 x 28 pixels wide. There are 616 input nodes in the input layer, 10 hidden nodes in hidden layer and one output in output layer. This is a simple structure which is fully connected. The number of hidden nodes was chosen on the basis of trials and errors with the training set to be as low as possible. The preparation of the training pattern were constructed manually and tested on the machine. The training is applied on the number of different RBC images containing the healthy RBC and sickled RBC. The images is recorded and converted into grayscale images for easy processing and given to the artificial neural network. The result found is the complete healthy RBC as well as incomplete non circular RBC i.e. sickled cells.

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RESULTS AND DISCUSSION

By applying the neural network on the supplied images, containing the complete images of RBC's, sickled cells, WBC's, the output occurs. The images counted were 92 images. The overlapping cells were removed and the successful complete cells extracted is RBC's = 42, WBC's=12. The WBC's extracted are bigger in size containing black spot inside it. The RBC's are the smaller darker shaped cells.

CONCLUSION

Here the multilevel perceptron model used, gives the 81% accuracy. It extracts the RBC's, Sickled Cells; WBC's as well as overlapped cells. Accuracy increases when training to the ANN increases.