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RESEARCH ARTICLE

BLOOD CELL ANALYSIS USING IMAGE SEGMENTATION AND COUNTING

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Abstract

Nowadays, the complete blood cell count (CBC's) is calculated manually in pathology labs. This traditional way is time consuming, so it needs some help in terms of software for blood cell analysis. This paper explains how the analysis of blood cell will be done.
The idea of this paper is to serve pathologists and medical technicians by using image processing techniques such as Pulse coupled Neural Network (PCNN) and segmentation to count the blood cells. PCNN is a model with multiple parameters, and finding the proper values of these parameters is a tedious task. So a simplified PCNN is put forward. The method can not only de-noise and segment blood cell image perfectly, but also can well eliminate disturbed objects. It is an accurate and cost-effective model to assist pathologists and medical technicians.

I. Introduction

In traditional terms, blood cell analysis i.e. complete blood cell count (CBC) is done as a "convention". In which it measures the red blood cells, white blood cells, usually assesses the size and shape of red blood cells as per old delayed procedures. Today in this busy hectic schedule; pathologists need some help in terms of software for blood cell analysis. Thus, the idea of our paper is to serve the pathologists, medical technicians for the same, by using Image Processing techniques. Due to cells' complex nature, it still remains a challenging task to segment cells from its background and count them automatically. The Pulse-Coupled Neural Network (PCNN) has been shown to be a very powerful image processing tool. Here we present a method for blood cell image segmentation and counting. The method can not only de-noise and segment blood cell image perfectly, but also can well eliminate disturbed objects which will seriously impact the blood cell counting step, and is able to segment specific isolated cell from its background. It is a novel use of Image Processing, as we take clean and properly stained blood cell sample image for our system, to assist the pathologists and medical technicians.

The differential counting of white blood cell provides invaluable information to pathologist for diagnosis and treatment of many diseases. Manually counting of white blood cell is a tiresome, time-consuming and susceptible to error procedure due to the tedious nature of this process, an automatic system is preferable in this automatic process, segmentation and classification of white blood cell are the most important stages. The objective of the present study is to develop an automatic tool to identify and classify the white blood cells namely, lymphocytes, monocytes and neutrophil in digital microscopic images. We have proposed color based segmentation method and the geometric features extracted for each segment are used to identify and classify the different types of white blood cells. The experimental results are compared with the manual results obtained by the pathologist and demonstrate the efficiency of the proposed method.

PCNN has been proved as the best technique to perform various important image processing techniques, such as, edge detection, segmentation and pattern matching. This paper uses PCNN technique. Fig. 1 shows the overall steps of the algorithm. Main procedure of the system is listed below:

1. Input image is taken from under microscopy. The image consists of blood cells taken from blood sample of a patient.
2. Noise is removed from the image by using various noise removal techniques such as Median filter.

3. Input image is a colored image and hence it needs to be converted in gray scale format. Gray scale conversion converts colored image in gray scale image.
4. Next step is edge detection of image, using edge detection techniques.
5. Image segmentation is a key technique in image processing. It affects the subsequent processing.
6. Pattern matching step is basically done for counting and classifying the blood cells.
7. The output obtained is total count and classification of blood cells.

II. Noise removal

Noise is any undesirable signal. Images are mostly degraded by such noise. Noise is everywhere and hence gets introduced into data via any electrical system used for storage, transmission and/or processing. The further processing of algorithms strongly depends on the noise removal results. Hence noise removal is important for obtaining accurate results. Image is de-noised using PCNN combined with median filter [2]. We found that PCNN has a unique characteristic that neurons in the same region with similar intensity tend to fire synchronously. Hence if a neuron cannot fire synchronously with its neighbors, it can be thought to be heavily degraded. Hence locating noised pixels and de-noising it can be done using appropriate algorithms such as Median filter. When performing median filtering, each pixel is determined by the median value of all pixels in a selected neighborhood. The value **m** is selected as a mid value amongst the population and the remaining population is divided into two halves in which one half has values smaller than m and the other half has values larger than m. These filters work using the firing nature of neurons in PCNN. This filter belongs to a class of edge retaining, smoothing filters. Such filters preserve small and sharp details of an image. Noise removal results are shown in Fig. 2.

III. Image Segmentation:

Image segmentation is the most important step and a key technology in image processing, and it will directly affect subsequent processing. With mathematical theories image processing has achieved great progress and a lot of novel segmenting algorithms have been proposed. But most algorithms have their own drawbacks. As for cell images, owing to complex nature, it still remains a challenging task to segment and count them.

IV. Algorithm for Blood Cell Counting and Specific Cell Segmentation

Blood cell counting is generally done in various pathological labs. Cell numbers can be roughly estimated with eyes under microscope. But this needs a lot of hard work and is also bad for eyes. In this we use methods that count blood cells automatically.

Firstly, find any connected components which may be 4-connected objects or 8-connected objects in a binary image, that is to say, any pixels linked in horizontal, vertical or diagonal direction are considered as a whole (object).

Secondly, we should mark the blood cells (the connected components) with serial numbers. We can label the connected components with certain number which represents its gray scale and serial number. Then each object will appear in a different gray scale, so that the objects can be easily distinguished. The pixels labeled 0 make up the background, the pixels labeled 1 make up the first image, and the pixels labeled 2 make up the second image, and so on. Using the morphological feature of ellipse or circle shape of cells, n is selected as 8, which means that any 8-connected objects (such as circle or ellipse shaped blood cells) in the image will be counted.

A. Contour Tracing Algorithms

Blood cell shapes can be considered as contours. These contours are necessary for the process of pattern matching which in turn is useful for counting and classification. There are many common contour tracing algorithms. The algorithm used here is square tracing algorithm. It has some weaknesses like; it ignores any holes present in the pattern. So first, a “hole searching” algorithm should be used and then contour tracing algorithm should be applied on each blood cell in order to extract a complete contour.

B. Square tracing Algorithm-

Square tracing algorithm is easy to implement and is used to extract the contours in the image. In a given pattern of black pixels on a background of white pixels i.e. a grid; locate a black pixel and declare it as your “start” pixel. In

the given image, every time you find a black pixel, turn left, and every time you find a white pixel, turn right, until you encounter the start pixel again. The black pixels traversed after this process will be the contour of the pattern.
The important thing in square tracing algorithm is the "sense of direction". The left and right turns you make are with respect to your current positioning. Therefore, it's important to keep track of your current orientation in order to make the right moves.

Algorithm

- scan the cells of **T** until a black pixel **s**, of **P** is found.
- Insert **s** in **B**.
- Set the current pixel, **p**, to be starting pixel, s.
- Turn left i.e. visit the left adjacent pixel of **p**.
- Update **p** i.e. set it to be the current pixel.
- While **p** not equal to s do

Input: A square tessellation **T**, containing a connected component of **P** of black cells.
Output: A sequence **B (b1, b2… bk)** of boundary pixels, i.e. the contour.
Begin

- Set **B** to be empty.
  From bottom to top and left to right
  If the current pixel **p** is black
    - insert **p** in **B** and turn left (visit the left adjacent pixel of **p**.)
    - Update **p**, i.e. set it to be the current pixel. else
    - turn right (visit right adjacent pixel of **p**.)
    - Update **p**, i.e. set it to be the current pixel.

end While

V. Conclusion

As we know that the presentation of Image segmentation mainly depends on PCNN parameters, but as far it is a strenuous work to get proper PCNN parameters and no paper has described this problem. Mainly parameters depends on large number of experiments and experiences. Due to immanent nature of PCNN, the mechanism can get flawless and ultimate result to de-noise and segment the Blood Cell Images. Furthermore our mechanism can compute the number of blood cells and segment specific cells from its locality , which is very vital to the evolution of cell segmenting and counting technology. Moreover , we studied the auto wave features of PCNN and applied it successfully in Cell Image Segmentation and it performs very well.

Although , since of the entanglement of cell images it is impossible for us to get a constant to segment any kind of cell images well. After having done a great investigation to different types of images we notice that our algorithm is only satisfactory for the cell image which has the homogeneous attributes(such as the size, shape and connections of cells) as animal blood cells, and the counting method mentioned above is not very accurate. For example, it is not precise for some adjacent and overlapping blood cells counting. And it is also difficult to use this method for plant cell segmentation because of their tangled constitution and vigor distribution, but this is adequate for biological investigation of cytological count at present. Our next step and further study is to do analysis of blood cells by directly connecting the microscope to the system for obtaining blood cells classification and counting.

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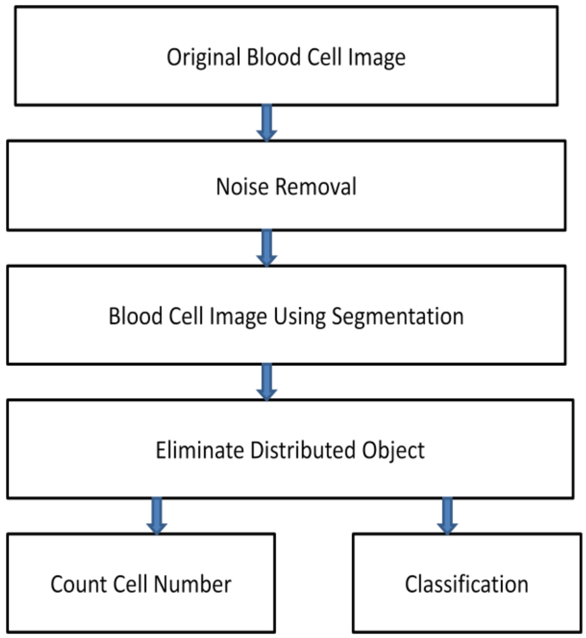

Fig.1. Overall steps of the algorithm

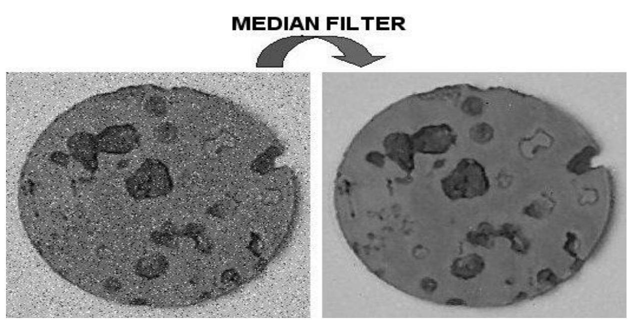

Fig. 2