A SURVEY OF SEMIAUTOMATIC WHITE BLOOD CELL SEGMENTATION IN MEDICAL IMAGE ANALYSIS

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Abstract: In medical image analysis, a single medical image can be estimated for a variety of cells in different stages of maturation, whose nucleus and cytoplasm might differ in shape, texture, color, granulite, and density. Hence the automatic cell segmentation remains a challenging problem to perform higher level tasks such as automatic differential counting, which plays an important role in the diagnosis of different diseases. To overcome these issues semiautomatic white blood cell segmentation method are used. In this paper we study the various types of white blood cell automation techniques. The limitations of these methods are also investigated. Further we address the common problem of resulted image classification with its possible theoretical solution and this survey concludes with further points for investigation.

Keywords: Medical image analysis, White blood cell image segmentation, Image extraction.

1. INTRODUCTION

The immune system, which is the third line of defense of the human body, protects the body from viruses, bacteria, and pathogens. This natural defense identifies and eliminates abnormal cells, such as tumor cells. The immune system consists of immune organs, immune cells, and immune molecules. White blood cells (WBCs) are the principal components of immune cells and play an important role in our body's immunity. In fact, WBCs normally have a constant concentration in the human blood. If the amount of WBC exceeds the normal range, then health problems may occur. The morphological analysis of WBCs is one of the basic steps of blood pathological analysis. Morphological analysis is traditionally performed manually, thus making this a tedious and time consuming process, even for an expert. Furthermore, morphological analysis is limited to the professional knowledge and eyesight of a pathologist.

Automatic methods have been developed in recent years to overcome the limitations of manual methods, which can cause calculation inaccuracies. Automatic devices use the principle of the light scattering method to calculate red blood cells (RBCs) and WBCs. The nuclei of WBCs are the areas of high contrast and are relatively easy to segment in blood smear image. Thus, first segment the nucleus part of the image before the cytoplasm part.

The remainder of this paper is organized as follows. In next section we present the study of various WBC segmentations. In section III we addressed the common problem of WBC segmentation and the conclusions are drawn in section IV.

2. WBC (WHITE BLOOD CELLS) SEGMENTATION TECHNIQUES:

White blood cells (WBC) or leukocytes play a significant role in the diagnosis of different diseases, and therefore, extracting information about that is valuable for hematologists. In the past, digital image processing techniques have helped to analyze the cells that lead to more accurate, standard, and remote disease diagnosis systems. However, there are a few complications in extracting the data from WBC due to wide variation of cells in shape, size, edge, and position. Moreover, since illumination is imbalanced, the image contrast between cell boundaries and the background varies depending on the condition during the capturing process.

Many works have been conducted in the area of general segmentation methods. Among the common segmentation methods are edge and border detection, region growing, filtering, mathematical morphology, and watershed clustering. An approach based on threshold segmentation followed by mathematical morphology and fuzzy cellular neural networks was proposed in [4] for WBC detection, but the method presents problems when distinguishing nucleus from cytoplasm.

Kumar et al. proposed a Teager energy

operator [10], which is used to segment the nucleus boundary and a simple morphological based method is applied to extract the cytoplasm. In this method the nucleus edges are detected effectively by teager energy operator but it required at least a weak edge to exist between red blood cell (RBC) and the background. Dorini et al proposed an automatic technique to segment the WBC nucleus and cytoplasm based on the fuzzy C-means algorithm and mathematical morphology operations [7]. However this procedure presents some limitations when dealing with arbitrary shaped cytoplasms by resulting poor classification during segmentation.

Clustering based techniques have been explored but typically present limitations when dealing with complex WBC images, requiring manual cropping in some cases. In [1], they used the hue, saturation, and value (HSV) color space model to build a 3-D histogram in order to extract the cytoplasm, and a scale-space filter to obtain the nucleus. The authors argued that the HSV space is more appropriate than the red, green, and blue (RGB) space in WBC segmentation due to its low correlation. The limitation is to deal cell images with low contrast between. Nucleus cytoplasm and background to avoid the common problem leaking.

Yampri et al [5] located the WBC components by using a shape analysis step based on a roughly boundary detection obtained by image thresholding. The boundary detection results are limited by the amount of noise present since the presence of noise causes a blurred resulted image.

3. NUCLEUS AND CYTOPLASM CLASSIFICATION PROBLEM IN WBC SEGMENTATION

Besides, being tedious and time consuming the traditional manual method for differential counting is hard to reproduce and subjective replying on the expert subjective assessment. This has motivated the development of automated or semiautomated methods. Several WBC image segmentation methods have been proposed, and are usually based on region- finding or contour detection schemes. Mathematical morphology transformations are considered by several authors.

In multi scale analysis, the nucleus and cytoplasm are regions are extracted and segmented to study the properties of white blood cell. However this process is difficult in case of dealing with high contrast cell images. The segmentation is also limited by the presence of noise. To overcome this issues a scale space operator can be used to extract the nucleus and cytoplasm portions of WBCs. It invokes two part process and the input images with an operator with scale space properties [7]. First is to segment the nucleus, we consider two well-known image segmentation techniques, namely the watershed transform and Level-Set methods. The second is to segment the cytoplasm by using mathematical morphology operations, such as the granulometric function and the combination of the bottom hat and area opening transforms. Thus a promising segmentation and classification results for varying cell appearance can be obtained with high image quality.

4. CONCLUSION

This article has presented a comprehensive survey of various WBC segmentation techniques. Several integration processes have been investigated and their limitations have also been dealt with. Beside the study of various WBC segmentation techniques we given the common nucleus and cytoplasm classification problem and tried to addressed it with possible theoretical solution. For future work, the proposed WBC segmentation framework should be implemented and to be analyzed with other WBC segmentation techniques.

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