Chapter 58
A Study on Segmentation of Leukocyte Image With Shannon's Entropy

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ABSTRACT

In recent years, a considerable number of approaches have been proposed by the researchers to evaluate infectious diseases by examining the digital images of peripheral blood cell (PBC) recorded using microscopes. In this chapter, a semi-automated approach is proposed by integrating the Shannon's entropy (SE) thresholding and DRLS-based segmentation procedure to extract the stained blood cell from digital PBC pictures. This work implements a two-step practice with cuckoo search (CS) and SE-based pre-processing and DRLS-based post-processing procedure to examine the PBC pictures. During the experimentation, the PBC pictures are adopted from the database leukocyte images for segmentation and classification (LISC). The proposed approach is implemented by considering the RGB scale and gray scale version of the PBC pictures, and the performance of the proposed approach is confirmed by computing the picture similarity and statistical measures computed with the extracted stained blood cell with the ground truth image.

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INTRODUCTION

Most of the infection/disease in human body is commonly assessed using bio-signals and images recorded with dedicated practices executed in a controlled environment. Compared to the medical imaging procedures, bio-signal based approaches are limitedly considered to evaluate the disease in human body; further it is normally adopted to examine the abnormality arising in vital human organs, such as brain, heart, muscles, digestive system, etc (Lin and Li, 2017; Paramasivam et al., 2017; Ranjan et al. 2018).

Recently, imaging methods are extensively adapted in medical domain to register internal and external organs of human body using approved imaging procedures. After recording these images, a clinical level evaluation is executed by means of a semi-automated and automated tool by an experienced imaging technician or the physician to get the pre-opinion regarding the infection/abnormality of the organ under assessment. Due to its importance and clinical significance, a variety of image processing methods are designed and considered to examine RGB and gray scale images recorded using a chosen imaging scheme. The imaging procedures, such as X-ray (Tuan et al., 2018), Magnetic Resonance Image (Palani et al., 2016; Rajinikanth et al., 2017; Rajinikanth and Satapathy, 2018), Magnetic Resonance Angiogram (Rajinikanth et al., 2018), Computed Tomography (Ashour et al., 2015; Fernandes et al., 2017; Naqi et al., 2018), Fundus imaging (Sudhan et al., 2017; Shree et al., 2018), Dermoscopy (Dey et al., 2018) etc., are widely discussed in the literature to examine infection in various organs of human body.

Along with the above said imaging procedures, clinical blood cell images recorded using Digital Microscope (DM) also play a vital role in medical field to identify the infection in a tissue/cell (Chakraborty et al., 2017). The DM images can be considered to inspect abnormal cell growth, blood infection due to cancer, AIDS, leukemia, malaria and other communicable diseases (Kamalanand and Jawahar, 2012; 2015; Hore et al., 2015; Lakshmi et al., 2015). The DM images of thick as well as thin blood smear are widely considered in the medical imaging literature to investigate a variety of diseases. Usually, the thin blood smear image is prepared in clinical level by means of collected blood samples from infected person and a staining agent, such as Leishman's stain, Giemsa stain, Jenner's stain, and Wright's stain. The staining medium is usually considered to differentiate a particular cell from the common group (Manickavasagam et al., 2014). After completing the preliminary recording task, the blood smear image is then registered with the DM in order to evaluate the infection by using a computer supported semi-automated/automated inspection practice.

The work of Rezatofighi and Zadeh (2011) confirm that, examination of Peripheral Blood Cell (PBC) by means of automated approach offers enhanced accuracy compared to other traditional techniques. Their work suggests that, an efficient assessment tool is necessary to examine the image to provide essential qualitative assessment and superior decision making during the segmentation and classification of white blood cell. Segmentation and classification of PBC is most important in hematological events. Their work also contributed a benchmark image dataset called Leukocyte Images for Segmentation and Classification (LISC); to test and validate the developed computer assisted blood cell examination and classification tools developed by the researchers.

In the literature, considerable schemes are proposed to examine the Region Of Interest (ROI) of Peripheral Blood Cell (PBC) pictures based on traditional and heuristic algorithm based methods (Manickavasagam et al., 2014). Previous research confirms that, heuristic approaches tender improved results contrast to the traditional schemes (Raja et al., 2014; Abhinaya and Raja, 2015; Balan et al., 2016; Anitha et al., 2017; Vishnupriya et al., 2017).