Chapter 17 Analysis of Blood Smear and Detection of White Blood Cell Types Using Harris Corner

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ABSTRACT

Blood cell smears contain huge amounts of information about the state of human health. This chapter proposes a Fuzzy c-means segmentation based method for the evaluation of blood cells of humans by counting the presence of Red Blood Cells (RBCs) and recognizing White Blood Cell (WBC) types using Harris corner detection. Until now hematologists gave major priority to WBCs and spent most of the time studying their features to reveal various characteristics of numerous diseases. Firstly, this method detects and counts the RBCs present in the human blood sample. Secondly, it assesses the detected WBCs to minutely scrutinize its type. It is a promising strategy for the diagnosis of diseases. It is a very tedious task for pathologists to identify and treat diseases by manually detecting, counting, and segmenting RBCs and WBCs. Simultaneously the analysis of the size, shape, and texture of every WBC and its elements is a very cumbersome process that makes this system vulnerable to inaccuracy and generates trouble. Hence, this system delivers a precise methodology to extract all relevant information for medical

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diagnosis with high germaneness maintaining pertinence. This present work proposes an algorithm for the detection of RBCs comparing the results between expert ophthalmologists' hand-drawn ground-truths and the RBCs detected image as an output. Accuracy is used to evaluate overall performance. It is found that this work detects RBCs successfully with accuracy of 82.37%.

INTRODUCTION

The number of WBCs present in human blood depends on several factors like coagulation and thickness of blood that in turn depends on age, tiredness and fatigue. The whole process of counting WBC from human blood samples is cumbersome and is in immense need for automation to lessen the burden of the hematologists in maintaining accuracy, while working within a stipulated time frame. This method proposes a new approach of time conscious methodology to detect, study and determine the shape, contour and type of the WBCs and its elements. Proper and accurate diagnosis of the peripheral and marginal elements of the blood cells results in determination of diseases ranging from inflammation to leukemia. In general, achieving the same desired result until now was a dreary and monotonous process for trained and expert professionals in the field of biomedical sciences. Along with these factors, the microscopic review also seeks a large time span that slows down the process of disease detection and treatment of the same increasing fatal consequences. White blood cells or leukocytes play major role in defending the body against both infectious disease and foreign materials. There are normally approx. 7000 white blood cells per µL of blood. White Blood Cells are of mainly two types:

- 1. Granulocytes
- 2. Agranulocytes

Those WBCs having granules in the cytoplasm are called granulocytes (neutrophil, basophil, eosinophil), and those devoid of granules are agranulocytes (monocyte, lymphocyte, macrophage). See Figure 1. Neutrophils have multilobed nucleus, basophils have bi or trilobed nucleus, eosinophils have bilobed nucleus, lymphocytes have highly stained, eccentric nucleus and monocytes have kidney shaped nucleus. Neutrophils make about 55%-70% of WBC, lymphocytes around 20%-40%, monocytes and macrophages about 2%-8%, eosinophils 1%-4% and basophils make up less than 1% of WBC. Any disbalance in the proportion or count of various components of WBC may indicate the presence of a disease. Neutrophils fight bacterial germs. Low count of neutrophil, called Neutropenia is caused due to chemotherapy, or viral infections and high count due to blood cancer Leukemia. Lymphocytes are of 2 types: The T-lymphocytes kill germs and the B-lymphocytes produce antibodies. Chronic infections and hereditary disorders lead to reduced number of lymphocytes (Lymphocytopenia). AIDS (Acquired Immunodeficiency Syndrome) cause CD4+T-lymphocytes to decrease drastically. Patients receiving chemotherapy or corticosteroids have low level of monocytes. Allergic reactions or Parasitosis elevate the level of eosinophil, resulting in Eosinophilia.

Also in this algorithm, the presence of the Red Blood Cells (RBCs) in the blood is counted. RBC (Harms, et.al., 1986; Bandyopadhyay et. al., 2012) is the chief component of human blood. RBCs give blood its characteristic red color. An RBC is a biconcave disc, without any nucleus. Its anomalies are the causes of many severe or fatal diseases. RBC maintains the hemoglobin level of humans and is responsible for oxygen supply to the entire body. The variations in human genetic or enzymatic pigments like Triglycerides lead to coagulation of RBCs and may be fatal causing heart blockages. Proper monitoring of the level 12 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

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