Chapter 46
Application of Biomedical Image Processing in Blood Cell Counting Using Hough Transform

Manali Mukherjee
Government College of Engineering and Ceramic Technology, India

Kamarujjaman
Government College of Engineering and Ceramic Technology, India

Mausumi Maitra
Government College of Engineering and Ceramic Technology, India

ABSTRACT

In the field of biomedicine, blood cells are complex in nature. Nowadays, microscopic images are used in several laboratories for detecting cells or parasite by technician. The microscopic images of a blood stream contain RBCs, WBCs and Platelets. Blood cells are produced in the bone marrow and regularly released into circulation. Blood counts are monitored with a laboratory test called a Complete Blood Count (CBC). However, certain circumstances may cause to have fewer cells than is considered normal, a condition which is called "low blood counts". This can be accomplished with the administration of blood cell growth factors. Common symptoms due to low red blood cells are: fatigue or tiredness, trouble breathing, rapid heart rate, difficulty staying warm, pale skin etc. Common symptoms due to low white blood cells are: infection, fever etc. It is important to monitor for low blood cell count because conditions could increase the risk of unpleasant and sometimes life-threatening side effects.

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INTRODUCTION

In biomedicine field, blood cells with complex behavior are very important. Nowadays, microscopic images are used in several laboratories for detecting cells or parasite by technician. The microscopic images of a blood stream contain Red Blood Cells (RBCs), White Blood Cells (WBCs) and Platelets. In medical field, the number of red blood cells is used as an indication factor for detecting the type of diseases such as malaria, anemia, leukemia etc. Pathological examination of an infected cell by disease, is only dependent on subjective assessment which usually leads to particular inter-observer variation in gradation and results delay in diagnosis. The problems using manual counting of RBC under the microscope tend to give inaccurate result and errors (Mazalan, S.M. et.al, 2013), (Tangsuksant, W. et.al, 2013). However, automatic cell count assessment still remains a challenging task as many of the cells are clumped in an image where segmentation is the primary aspect as well. Hari, J.; Prasad, A.S.et.al., 2014 worked on Separation and counting of blood cells using geometrical features and distance transformed watershed. Because of cell's complex nature, it is difficult to segment cells from its background and count them automatically. Dwi Anoragaingrum et.al, showed cell segmentation with median filter and mathematical morphology operation. Keng Wu et al. worked on live cell image segmentation. Mark B. Jeacocke and Brian C. Lovell proposed a Multi-resolution algorithm for Cytological image segmentation. Blood is unique among all tissues of the body because it exists as the only fluid tissue. According to H Elaine & N. Marieb (2006), a blood cell can be any type of cell normally found in blood which falls into four categories which are red blood cell, white blood cell, platelet and plasma. The differences between these groups lie on the texture, color, size, nucleus morphology and cytoplasm. In blood cells, number of red cells is many more than white blood cells. For example an image may contain up to 100 red blood cells and only 1 to 3 white blood cells. Platelets are small particles and are not clinically important (Fatemeh Zamani, et.al. 2006*).* Blood cells form in the bone marrow, the soft material in the center of maxium bones. WBCs (Leukocytes) are cells involved in defending the body against infective organisms and unknown substances. Leukocytes or white blood cells containing granules are called granulocytes (composed by neutrophil, basophil, eosinophil). Lymphocyte and monocyte Cells are called agranulocytes i.e., without granules cells. These cells provide major defense against infections in organisms and their specific concentrations can help specialists to discriminate the presence or the absence of very important families of pathologies (Vincenzo Piuri et.al., 2004).

Blood counting is synonym with the complete blood count or CBC which refers to combination of Red Blood Cell (RBC), White Blood Cell (WBC), platelet, hemoglobin and hematocrit. They have their own role in the body system and the counting result is important to determine the deficiency or the capability of the body system. In short, any abnormal reading of CBC can give a sign of infection or disease. For example, the presence of bacterial infection is diagnosed from increasing WBC count. On the other hand, specific low vitamin may come from a decreased RBC and thrombocytopenia is referring to low platelet count. The result can influence physician to make the best response and monitor the drug effectiveness from the blood count (Miswan, M. F., et al., 2011).

Complete blood count (CBC) consists of several counting of the main component in the blood cell. Each of the components have a standard quantity range as a reference for a healthy women and man. Out of the range values are considered to be abnormal and physician interprets the result for further action. As the manual counting method is not very accurate, nowadays, computer based technology is used to count the cells more accurately. Usually, there are four steps involved in counting the blood cells. These are acquisition, pre-processing, segmentation, feature extraction and estimation. The first step involves