

## Chapter 17

# An Automated Method for Differential Blood Counting Using Microscope Color Image of Isolated WBC

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### **ABSTRACT**

*Healthcare Delivery Systems are becoming overloaded in developed and developing countries. It is imperative that more efficient and cost effective processes be employed by innovative applications of technology in the delivery system. One such process in Haematology that needs attention is “Generation of report on the Differential Count of Blood”. Most rural centers in India still employ traditional, manual processes to identify and count White Blood Cells under a microscope. This traditional method of manually counting the white blood cells is prone to human error and time consuming. Medical Imaging with innovative application of algorithms can be used for recognizing and analyzing the images from blood smears to provide an efficient alternative for differential counting and reporting. In this regard, the objective of this paper is to provide a simple and pragmatic software system built on innovative yet simple imaging algorithms for achieving better efficiency and accuracy of results. The resulting workflow process has enabled truly practical tele-pathology by enabling e-collaboration between lesser skilled technicians and more skilled experts, which cuts down the total turnaround time for differential count reporting from days to minutes. The system can be extended to detect malarial parasites in blood and also cancerous cells.*

DOI: 10.4018/978-1-4666-0909-9.ch017

## **INTRODUCTION**

Healthcare Delivery Systems are the key to a prosperous India in the future. There is a need to bring in new leadership in the complex and changing healthcare requirements. India needs to achieve organizational excellence by designing new service delivery models that will increase the efficiency of healthcare delivery. In India, the size of Healthcare industry is about Rs 850 billion for the year 2007 with an estimated growth rate of 13% year on year over the next five years. There are always more patients than can be looked after and more healthy people to be monitored in order to minimize the risk of being ill. Hence for performing required tasks in health sector more efficiently, intelligent systems are always necessary. Creating efficient systems of healthcare delivery using Information Technology will assist in improving the quality of healthcare and make it more affordable.

One such system that can be automated is finding the differential blood count and the detection of malaria parasite infections / cancerous cells. In most of the phases of medical diagnosis and screening, a person's blood is routinely analyzed. Any level of automation in this analysis is appreciated greatly since it reduces the workload of medical experts and improves the turnaround time in obtaining blood test reports for the patients. The White Blood Count or leukocyte count reveals important diagnostic information and patient recovery status during follow-up. The haematologist requires two types of blood count for diagnosis and screening. The first one is called the Complete Blood Count (CBC) and the second one is called the Differential Blood Count (DBC). CBC could be done by instruments called Cytometers which provide approximate information about the cell composition in blood. On the other hand, DBC is more reliable but currently it is a manual procedure done by haematologists using microscope. In DBC, an expert counts white blood cells on the smear at hand and computes

the percentage of occurrence of each type of cell. The results reveal important information about patient's health status.

## **Objective**

Our objective in Medical Image Analysis for Computer-Aided Detection in Haematology is to provide a cost effective means by which routine blood test for differential count may be automated. Specifically, the system should be affordable, practical and usable in current day rural environments and locations where mass screening is done. As such, some of the important aspects to be addressed are:

1. The system should be usable by technicians in diagnostic laboratories/hospitals.
2. Response times should be quick enough to cater to practical needs of the diagnostic laboratories.
3. Absence of an obvious indication of a disease/health condition to be indicated clearly.
4. Possible presence of an indication of a disease/health condition to be flagged by the system for further analysis by an expert – thereby optimizing expert's time.

Our objective is not to replace an expert. However, our endeavor is to optimize the usage of valuable time on patients where expert's opinion is crucial.

## **Composition of Blood**

Blood is composed of various types of blood cells suspended in fluid called plasma. Blood cells (Dacie & Lewis, 1994) are formed in the bone marrow. Red Blood Cells (RBC) or Erythrocytes carry oxygen from the lungs to the rest of the body. White Blood Cells (WBC) or Leukocytes help fight infections and aid in the immune process. Platelets or Thrombocytes help in blood clotting. WBCs are responsible for the defense system in

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