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Blood Cell Counting using Image Processing Techniques: A Review

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Abstract: ***A complete blood cell count or CBC is considered as an important test in medical diagnosis to evaluate the overall health of a patient. Red Blood Cell count plays a vital role in identifying a person's health condition. The conventional method of blood counting is done manually by placing the blood smear under microscope that requires the skill of a pathologist. This manual counting of blood cells can lead to erroneous results and medical labouratory technicians are put under stress. The development of image processing technique and computer aided system will help to obtain precise results in less amount of time.***
Keywords: Complete Blood Cell count, Hough transform, Spectral Angle Mappings, support Vector Machines, Hyperspectral imaging system

I. INTRODUCTION

Blood is the life-maintaining fluid that circulates through the entire body. Blood consists of the following components:

1) Plasma. The liquid component of the blood in which the following blood cells are suspended.
2) Red blood cells (erythrocytes). These carry oxygen from the lungs to the rest of the body
3) White blood cells (leukocytes). These help fight infections and aid in the immune process. Types of white blood cells include:
4) Lymphocytes
5) Monocytes
6) Eosinophils
7) Basophils
8) Neutrophils
9) Platelets (thrombocytes). These help in blood clotting.

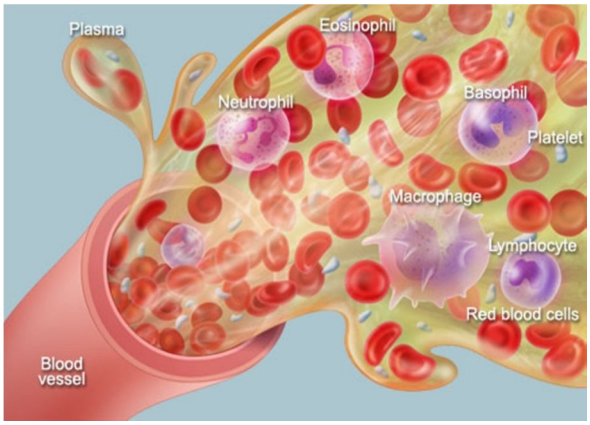


Fig 1: Components of a blood

Blood cells are produced in the bone marrow. The bone marrow is the spongy material in the center of the bones that makes all types of blood cells.
There are other organs and systems in our bodies that help regulate the blood cells. The spleen, lymph nodes, and liver helps to regulate the production, destruction, and function of the blood cells. The production and development of new blood cells in the bone marrow is called as hematopoiesis. The blood cells produced in the bone marrow start out as stem cells. A stem cell or a hematopoietic stem cell is the first phase of all blood cells. As the stem cell matures, several distinct cells like red blood cells, white blood cells, and platelets evolve. Immature blood cells are called blasts. Some blasts stay in the bone marrow to become mature cells. Others travel to other parts of the body to develop into mature cells and the functioning of blood cells.

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The main job of red blood cells, or erythrocytes, is to carry oxygen from the lungs to different body tissues and carbon dioxide as a waste product, away from the tissues and back to the lungs. Oxygen transport from the lungs to all parts of the body is carried out by an important protein in the red blood cells called Hemoglobin (Hgb). The main job of white blood cells, or leukocytes, is to fight against infection. There are several types of white blood cells and each has its own role in fighting viral, bacterial, fungal, and parasitic infections. Most important Types of white blood cells that protects the body from infection and foreign cells are Neutrophils, Eosinophils, Lymphocytes, Monocytes, Basophils.

A CBC count is a measurement of number, size, and maturity of the different blood cells in the blood sample. A CBC can be used to identify the problems with either the production or destruction of blood cells. Variations from the normal number, size, or maturity of the blood cells means there is an infection or disease process. When there is an infection, the number of white blood cells will be elevated. Many forms of cancer can affect the production of blood cells. For example, an increase in the immature white blood cells in a CBC can be associated with leukemia. Blood diseases, such as anemia and sickle cell disease, will cause an abnormally low hemoglobin.

II. RELATED WORKS

In [1], they proposed a method for blood cell counting and segmentation system using feature based segmentation, erosion, image subtraction, and convex hull and convex segmentation for detecting and eventually counting blood smear samples. They had deviced an algorithm to perform blood cell image analysis, segmentation and cell counting. This algorithm has divided into three stages; at the 1st stage they extracted the white blood cells and in the other two stages extraction of single cells and overlapped cells has done. As the first step the segmentation of the blood smear image in l*a*b space is done. Segmentation of an image is a cardinal task in the image analysis process that constitutes division of the image into many segments for the identification of objects of interest from its backgrounds. Since they used l*a*b, the image is divided into three different layers, namely l, *a, *b where, l, *a, *b stands for brightness or luminosity, hue or saturation layer along the red axis and hue and saturation layer along the blue axis respectively.

In [2], presents a method for the automation identification and classification of red blood cells in different classes of interest for diagnosis using microscopic blood smear images. They used different image processing techniques such as binarization, contrast enhancement, noise elimination, morphological operations like dilation, erosion, labeling, and extraction of some features of interest like area, perimeter, diameter etc.

Using all these information, some factors involved in the classification of red blood cells like circularity factor, form factor and deviation factor has calculated. The classification process has two phases: first they separated red cells in normal and abnormal type and secondly classified the abnormal into three different subclasses. This system does not aim to replace the pathologist, but to assist them and to improve the execution time of these types of analyzes.

In [3], they proposed a method for counting total number of RBC in peripheral blood smear image by using circular hough transform (CHT) method.

The process involves preprocessing and segmentation of a single RBC cell image after cropping it to get the minimum and maximum radius of the cell. After that they applied the CHT method to detect and count the number of RBC based on the range radius of the cells.

In [4], they proposed a system that aims to provide a method to count the red blood cells(RBCs), automatically by analyzing blood cell images collected from a microscopic hyperspectral imaging system. The classification algorithm spectral angle mappings (SAMs) and Support vector machines (SVMs) are used to segment blood cell images. In order to identify RBCs in the image, standard RBC model has been built to match RBCs in the segmentation results based on SAM classification algorithm.

In [5], they proposed a new approach for semi-automated counting of RBCs. They used hough transform in this paper. Hence the dimension of RBC can be specified by dragging two points over the image and then applied the hough transform for the detection of oval and biconcave shape of RBC with the specified diameter.

III. CONCLUSION

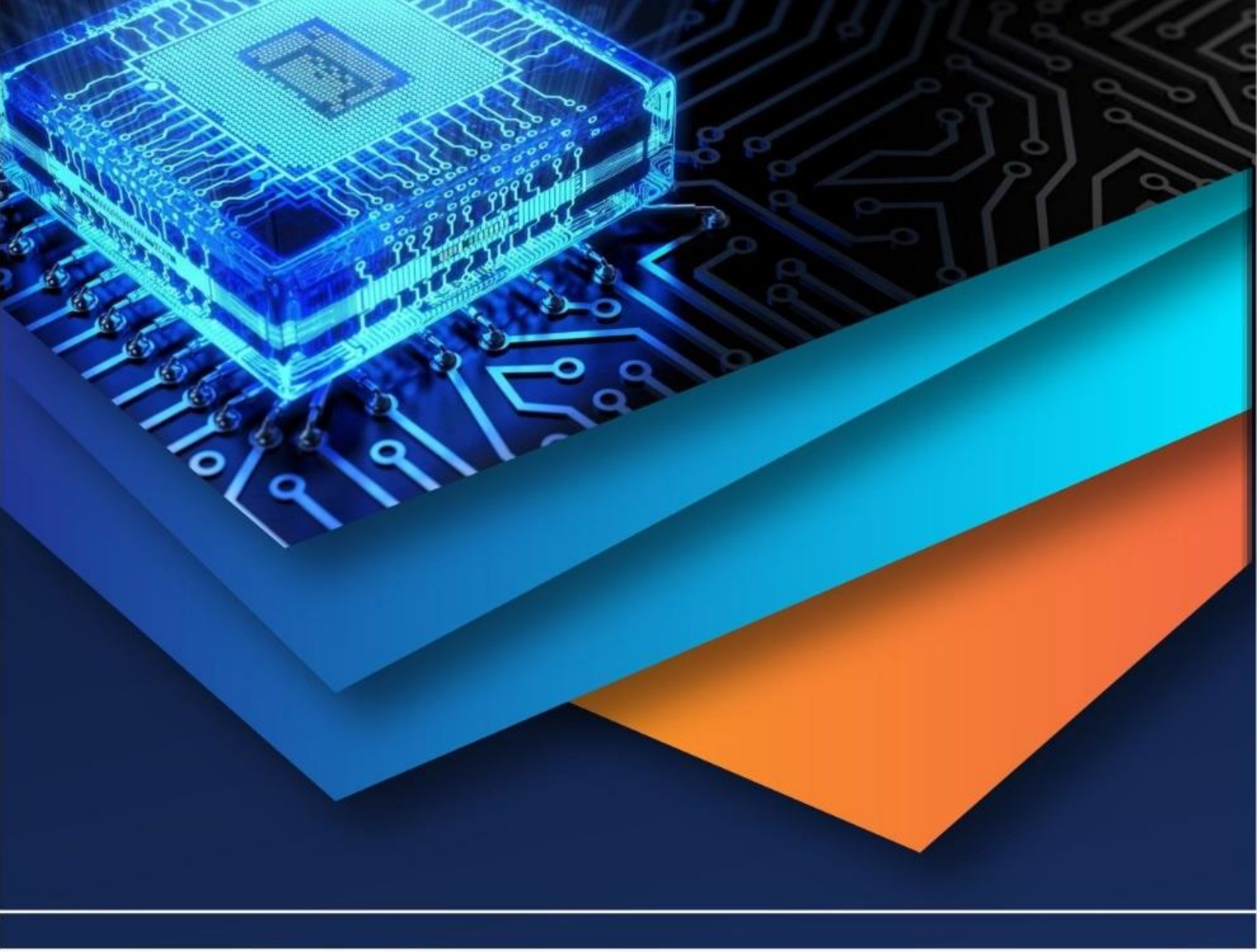
Blood cell count plays a vital role in the determination of overall health condition of a person. But the conventional method is highly dependent on manpower. This may lead to less accuracy. Hence an automated method for counting of blood cells has to be implemented.

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