DETECTION OF LEUKEMIA IN HUMAN BLOOD SAMPLE BASED ON MICROSCOPIC IMAGES

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Abstract-Leukemia disease is one of the leading causes of death among human. Its cure rate and prognosis depends mainly on the early detection and diagnosis of the disease. At the moment, identification of blood disorders is through visual inspection of microscopic images by examining changes like texture, geometry, color and statistical analysis of images. This paper describes a preliminary study of developing a detection of leukemia types using microscopic blood sample images. Image analyzing is through images is very important role play in the diseases can be detected and diagnosed at earlier stage. Images are used as they are cheap and do not require expensive testing and lab equipments. In this paper used detection of leukemia cells in normal blood cells using MATLAB.

Keywords: Microscopic blood cell Images, MATLAB.

1. INTRODUCTION

Leukemia is a type of cancer that affects the white blood cells. These affected white blood cells capture the bone marrow, bone marrow is the soft materials present in the center of most of the bone. These abnormal white blood cells stay in bone marrow and reproducing in an uncontrolled way. In these way normal healthy white blood cells is in covered to abnormal white blood cells. And due to these unhealthy and abnormal white cells human body is less able to fight of infections. These abnormal white blood cells also affected to red blood cells and platelets. Affected red blood cells lead to less oxygen being delivered to the organs and tissues of human body (Figure-1). This is called anaemia, and it can make you feel tired and breathless. And affected platelets can lead to problems with the blood-clotting and result of this blood –clotting is bleeding and bruising much more easily in day by day life..

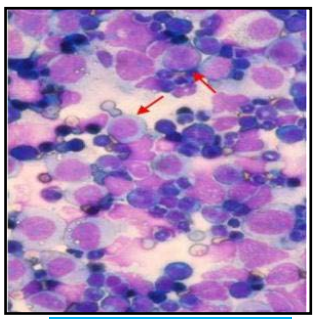

Figure-1: Leukemic Image

The early and fast identification of the leukemia, greatly aids in providing the appropriate treatment for the particular type. And Its detection starts with a complete blood count (CBC). If the count is abnormal, the patient is suggested to perform bone marrow biopsy. Once the patient confirm the presence of leukemic cells, a study of morphological bone marrow and peripheral blood slide use to analysis the type of leukemia. The abnormal cells in their particular types and subtype of leukemia, a hematologist will observe some cells under a light microscopy looking for the abnormalities presented in the nucleus or cytoplasm of the cells. The clinical behavior of the disease can be predicted using this classification and accordingly treatment should be given to the patient. In leukemia disease, large numbers of abnormal white blood cells are produced by bone marrow due to unknown cause. In pathology manual detection of leukemia is done which is time consuming as well as costly due to high cost pathology instruments. Hence automatic technique is adopted for fast and accurate results. In this technique image of blood sample is processed and nucleus part is segmented and finally cells are classified whether they are blast or normal one. Cells are produced by bone marrow due to unknown cause. In pathology manual detection of leukemia is done which is time consuming as well as costly due to high cost pathology instruments. Hence automatic technique is adopted for fast and accurate results. In this technique image of blood sample is processed and nucleus part is segmented and finally cells are classified whether they are blast or normal one.

BACKGROUND

Leukemia that starts in the tissue that forms blood. To understand the concept of cancer, it helps to know how normal blood cells form. Normal Blood Cells develop from of cells in the bone marrow called Stem cells. Stem cells classify into different kinds of blood cells.

Figure-2: a) White blood cell b)Red blood cell c)Platelets

White blood cells help to fight infection in the human body. There are several types of white blood cells shown in figure-2(a).
Red blood cells use for carrying oxygen to tissues throughout the human body shown in figure-2(b)
Platelets help to blood clots that control bleeding in the human body shown in figure-2(c).
Above white blood cells, red blood cells, and platelets are use for made stem cells as the human body needs them.

When blood cells grows old or to get damaged, they die, and body produce new cells take their place

Figure-3 shows how stem cells can be mature into different two types of white blood cells. First myeloid stem cell and second lymphoid stem cell:

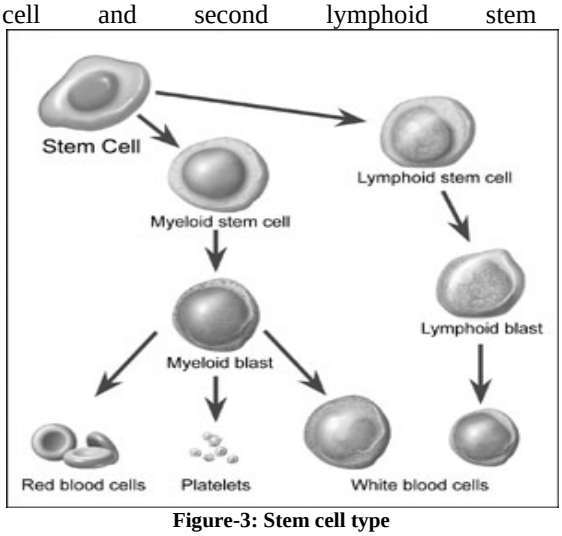

Figure-3: Stem cell type

A myeloid stem cell converts into a myeloid blast. The blast can be form a red blood cell, platelets, or one of the several types of white blood cells.

A lymphoid stem cell converts into a lymphoid blast. The blast can form one of the several types of white blood cells, such as B white blood cells or T white blood cells. Both the white blood cells that form from myeloid blasts are different from the white blood cells that form from lymphoid blasts.

Leukemia Cells:

In a person with leukemia, the bone marrow makes and presents abnormal white blood cells. The abnormal white cells are leukemia cells present in the human body..

Unlike normal blood cells are leukemia cells these cells not die when they produce. They may attach to the normal white blood cells, red blood cells, and platelets. This abnormal cell makes difficult for normal blood cells to do their work properly.

Types of Leukemia

The types of leukemia can be grouped based on the disease develops and gets worse. Leukemia is either chronic or acute types of Leukemia

The types of leukemia can be grouped based on how quickly the disease develops and gets worse. Leukemia is either chronic (which usually gets worse slowly) or acute (which usually gets worse quickly)

There are two common types of chronic leukemia:

Chronic leukemia: In chronic leukemia is not detected to the primary stages because in the primary stage this type of leukemia not affect the working of normal white blood cells and for this reason the patient not finding any types of symptoms. Doctors often find chronic leukemia during a routine check-up before there are any symptoms.

Slowly, chronic leukemia gets worse and the number of leukemia cells in the blood increases, patient get symptoms, such as swollen lymph nodes or infections. When symptoms appear this indicates that leukemia is at its last stage that means it capture the maximum part of the blood cells and bone marrow they are usually mild at first and get worse gradually.

There are two common types of chronic leukemia:

1. Chronic Lymphocytic Leukemia (CLL) – Chronic lymphocytic leukemia mostly detected to the adults.

In which lymphocytes look fairly normal but are not fully mature and do not function correctly against abnormal cells. The malignant or abnormal cells are found in blood cells and bone marrow, collect in and enlarge the lymph nodes. CLL cells shown in Figure-4.

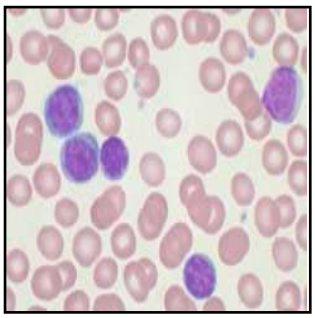

Figure-4: Chronic Lymphocytic Leukemia (CLL)

2. **Chronic Myelogenous Leukemia (CML)** – also known as a myeloproliferative disorder. CML cells shown in Figure-5. It is a disease in which bone marrow cells proliferate outside of the bone marrow tissue. It affects lymphoid cells and grows quickly.

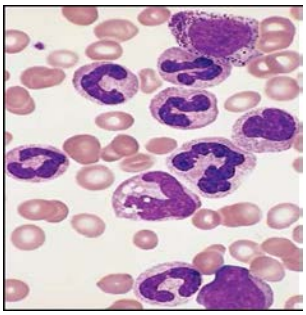

Figure-5: Chronic Myelogenous Leukemia (CML)

Acute leukemia: In acute leukemia also in the primary stage of leukemia, leukemia cells can not affect the working of normal white blood cells. But in the next stage this leukemia cells increases rapidly and uncontrolled. The types of leukemia also can be grouped based on the type of white blood cell that is affected. See the picture of these cells.

There are two common types of acute leukemia:

1. **Acute Lymphocytic Leukemia (ALL)** – also known as acute lymphoblastic leukemia. It is rapidly progressing form of leukemia that is characterized by the presence in the blood and bone marrow of large number of unusually immature white blood cells destined to become lymphocytic. ALL cells shown in Figure-6.

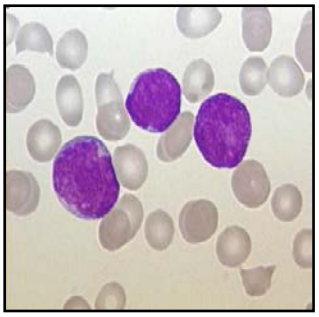

Figure-6: Acute Lymphocytic Leukemia (ALL)

2. Acute Myelogenous Leukemia (AML) – also known as acute nonlymphocytic leukemia (ANLL). This is the most common form of adult leukemia. It affects myeloid cells and grows quickly. Leukemic white blood cells collect in the bone marrow and blood. AML cells shown in Figure-7.

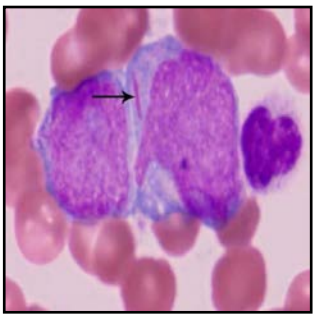

Figure-7: Acute Myelogenous Leukemia (AML)

From above all discussion images of leukemic cells ALL, AML, CLL, or CML shown in following Figure-8

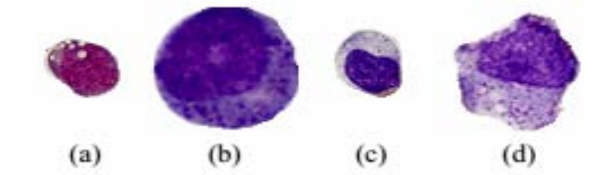

Figure-8: Examples of leukemic blood cells showing the four different types of leukemia: (a) ALL, (b) AML, (c) CLL, and (d) CML

FUNDAMENTAL STEPS IN IMAGE PROCESSING

Image Acquisition: In image acquisition, acquiring an image in digital form and pre-processing such as scaling.

Image Enhancement: The principle objective of enhancement is to process an image so that the result is more suitable than the original image for a specific application.

Image Restoration: As in image enhancement, the principle goal of restoration techniques is to improve an image in some predefined sense.

Image Compression: Minimizing the size of an image without degrading the quality of the image to an unacceptable level to conserve memory.

Image Segmentation: Segmentation is the principal approach used in this category. the region-based segmentation approaches in the second category are based on partitioning an image into regions that are similar according to the predefined criteria.

Color Image Processing: Adding color to gray scale image so as to improve description of the image and better human perception.

DESIGN

The design of this project cost is very less due to the use of basic methods like clustering segmentation, for edge detection and morphological methods such as erosion and dilation for smoothing. All these methods are low cost and simple and give us the desired output if applied in the correct sequence and in the correct way with appropriate parameters. Initially we discuss the fundamental steps for making the image more suitable for human perception and comprehension. Once we get a more detailed and descriptive image, we perform a set of operations on the image so as to predict the presence of Lymph ob-lasts in the collection of cells in our given sample and we try to extract that cell using morphological methods. We perform processes such as scaling, noise correction, threshold, edge detection, geometric feature extraction etc.

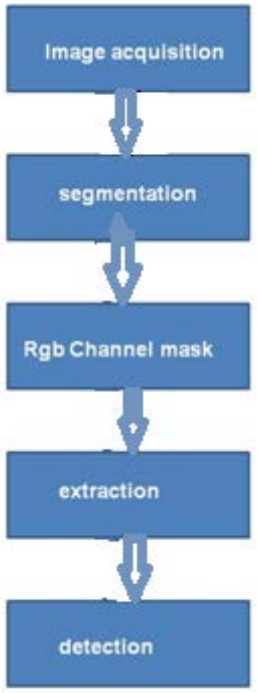

Figure-9: Implementation design process

The output of this method provides us with a specific area of our initial sample in which we presume that the malignant cell resides. This is done by observing the cell boundary closely to observe its shape. If the shape coincides with any geometric feature (circular, oval, etc) we deduce that the cell is not infectious. On the other hand, if the cell boundary doesn't coincide with any geometric figure, it may be inferred that the cell is malignant and the patient requires immediate treatment.

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METHODOLOGY:

1. Acquisition: Blood image from slides will be obtained with effective magnification.

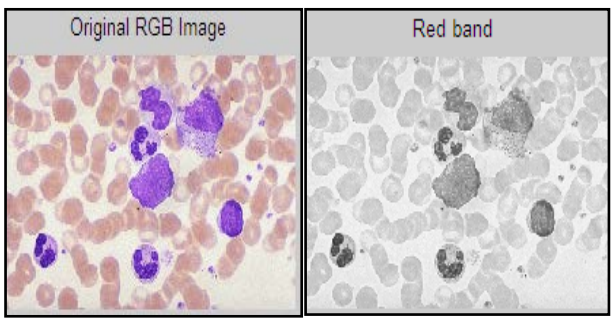
2. Pre-processing: During image acquisition and excessive staining, the images will be disturbed by noise. The noise may be due to illumination or shadows that make region of interest (ROI) appear as blurred image region. Background will be excluded since our ROI will be white blood cells. During this pre-process, image enhancement will be done, as the contrast enhancement technique is capable to improve the medical image quality.

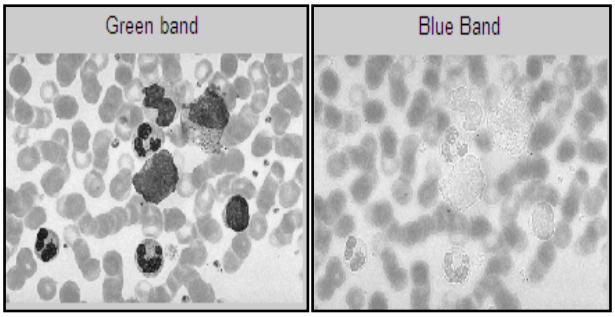
3. Segmentation: Segmentation of white blood cell and determination of ROI, which is nucleus for white blood cell only. This is done because in leukemia cell images, the cytoplasm is scanty. So, focus will be on nucleus of white blood cell only. Determination the types of white blood cell should be done from the nucleus. Only lymphocytes and myelocytes should be considered and need to determine them whether they are blast cells or not. Once the blast cells are determined, and then proceed to the next step. Sub images containing nucleus only will be considered. This is to reduce errors since there are similar color scales in white blood cells with other blood particles.

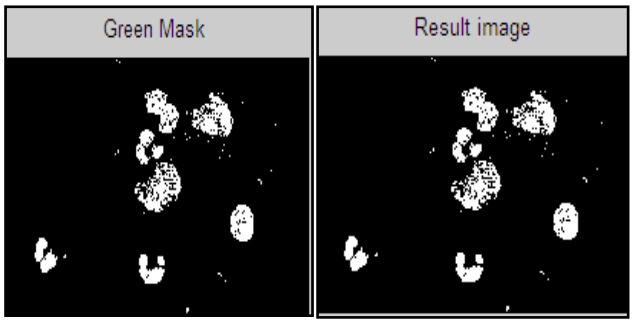
4. Feature Extraction: The most important problem in generation of features of blood cells that characterize them in a way enabling the recognition of different blast types with the highest accuracy. The features to be used are for nucleus of lymphocytes and myelocytes. Geometrical Features – which includes area, radius, perimeter, symmetry, concavity, compactness, solidity, eccentricity, elongation, form factor will be obtained. Texture Features – which includes homogeneity, energy, correlation, entropy, contrast and angular second momentum will be obtained. Color Features – the red, green and blue color spaces will be transformed into Green color spaces. Their mean color values will be obtained.

5. Detection: The suitable recognition of leukemia cells requires the definition of good descriptive features. White spaces is placed in the region of the leukaemia cells.

Following figures obtain to using MATLAB.







CONCLUSION:

From above all discussion the medical laboratory images using the MATLAB programming the different operation perform on the images like as enhancement, restoration, segmentation and color image processing using this method obtained the edge of cancerous blood cells. This cancerous blood cells in abnormal in shape and size. If the cancerous blood cells detected to give advice to further for exact detection types of cancer using medical laboratory and advice from doctors.

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