White Blood Cell Segmentation and Detection in Leukaemia Cancer: A Review

Jeenia[1], Inderpreet Kaur[2]
[1]M. Tech (Scholar), [2]Assistance Professor
Department of Computer Science Engineering
Rayat Bahra Group of Institutions, Patiala, Punjab (India)

Abstract – In this paper, we are introducing the Disease of Leukaemia or called cancer of blood cell. Leukemia is a disease or type of blood cancer, which characterized by an abnormal accumulation of white blood cells (leukocytes) and its precursors which disable its function of fighting infection. Early detection of the disease is necessary for proper treatment management Several Types i.e. acute lymphoblastic, Chronic lymphocytic, Acute myeloid, Chronic myeloid leukaemia and signs and symptoms of leukaemia. We've also explained the white blood cells, its types and purpose of WBC count. Several previous researches were also reviewed to get better view about leukaemia in detail. Segmentation is generally known as partitioning of an image is one of the intrinsic parts of any image processing technique. We have presented general review segmentation techniques used for Leukaemia detection.

Keywords – Leukaemia detection, Disease, ALL, Chronic lymphocytic and Segmentation.

I. INTRODUCTION

Leukemia is a type of blood cancer, initiated in bone marrow [1], where blood cells are accomplished. The bone marrow start making un-natural white blood cubical, referred to as leukaemia cells, but don't works like white blood cells. They develop remarkably faster than normal cells. At a point, Leukaemia cells outnumber the regular blood cells, which results in critical issues like bleeding, anaemia, infectivity, etc. These cells can spread to lymph nodes and other organs and causes bulge or pain [2].

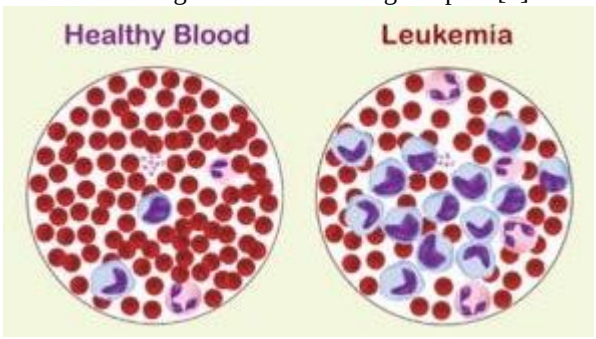

Fig: 1.2 (a): Leukaemia

Leukaemia exists in various types. Specifically, leukaemia is gathered by how quickly it gets poorer and changes which type of white blood cell. The blood cells are experimented to discover several diseases. Variations in blood conditions exhibit the expansion [3] of ailment in entity. Leukaemia is a cause of demise in case left untreated. Depending upon the quantity of data demonstrate that leukaemia is 5th reason of demise in men and 6th reason of death in women. Leukaemia establish in bone marrow. Each bone consists of a thin material inside itself, which also known as bone marrow as shown in figure. 1.2 (b).

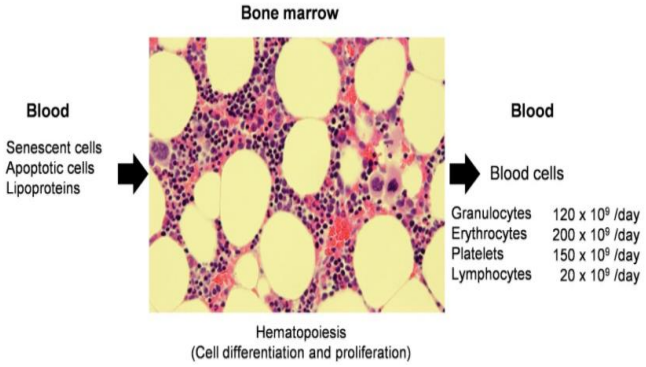

Fig: 1.2 (b) Bone Marrow and bone component

II. TYPES OF LEUKAEMIA

It is broadly categorized as:

A. Acute lymphoblastic leukaemia - Acute lymphoblastic leukaemia (ALL) is a type of cancer that causes the body to make too many white blood cells (lymphocytes). But these lymphocytes, called leukaemia cells, cannot fight infection very well.

B. Chronic lymphocytic leukaemia - Chronic lymphocytic leukaemia (CLL) is a type of cancer that starts from cells that become certain white blood cells (called *lymphocytes*) in the bone marrow. The cancer (leukaemia) cells start in the bone marrow but then go into the blood.

C. Acute myelogenous leukaemia - Acute myeloid leukaemia (AML) is a type of cancer that affects the blood and bone marrow. AML is characterised by an overproduction of immature white blood cells, called myeloblasts or leukemic blasts. These cells crowd the bone marrow, preventing it from making normal blood cells.

D. Chronic myelogenous leukaemia - Chronic myeloid leukaemia (CML) is a type cancer that affects the blood and bone marrow. In CML the bone marrow produces too many white cells, called granulocytes.

1.2 Sign and Symptoms: Various indications that might variate on the basis of type or stage of leukaemia in a patient. Although some common symptoms are [4]:

(i) A new lump or swollen gland in your collar, below your arm, or in your projection.

(ii) Recurrent nosebleeds, flow from the gums or rectum, additional frequent staining, or extremely heavy menstrual bleeding.
(iii) Frequent fever.
(iv) Night sweats.
(v) Bone aching.
(vi) Inexplicable appetite defeat or recent weight defeat.
(vii) Feeling tired a lot without a known cause.

III. WHITE BLOOD CELLS

White platelets are greater in estimate than red platelets. The attentive performance of white platelets provide basic data to discover several ailments. White platelets are classified into 5 composes: Neutrophil, Basophil, Eosinophil, Lymphocyte and Monocyte as appeared in Figure 1.2.2.1. These cells battle against ailments and secure our body [5]. White platelets are additionally called leukocytes or leucocytes. All white platelets have cores, which distinguish them from other cells, i.e. the RBCs and platelets. The quantity of leukocytes in the blood is frequently a marker of malady and subsequently the WBC check is critical subset of entire blood tally. A WBC tally can identify shrouded contaminations inside your body and ready specialists to undiscovered restorative conditions.

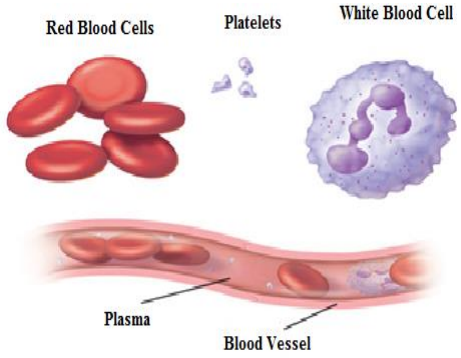

Fig: 2.1 White Blood Cells

2.1.1 Types of White Blood Cells

(i) Neutrophil

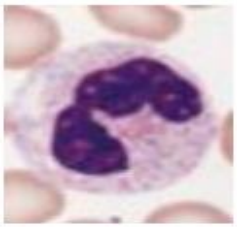

Fig: 2.1.1 (a) Neutrophil

Description- This cell have nucleus consists of cytoplasm (a jelly-like material). Its granules are of 2 types: primary and secondary. Primary granules discover at pro-myelocyte phase while secondary granules discovered at myelocyte phase. Its diameter is 12-15 micro-meters (μm). They are short-lived and highly motile. Neutrophils are the first-responders of provoking cells to shift to the provoking sites in case of environmental exposure, bacterial infection, and few cancers. Neutrophils are most plentiful WBCs in humans approximately 10^{11} are produced daily; they account for approximately 50-70% of all white blood cells (leukocytes) [6].

(ii) Eosinophil

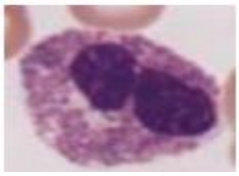

Fig: 2.1.1 (b) Eosinophil

Description- These look very similar to the neutrophil. The only change is in the cytoplasmic granules which are red. They insert seditious exudates. They react to the allergies. The diameter of it is 12-15 μm. Eosinophils develop and mature in the bone marrow.

(iii) Basophil

Fig: 2.1.1 (c) Basophil

Description- Basophils can be found only in normal peripheral blood. Basophils are having more no of cytoplasmic granules (small particles) in it. These granules overlie nucleus. The diameter of it is 9-10 μm. Anticoagulant heparin, is comprised in Basophils, which prevents blood from clotting too quickly. They are mostly found in the skin and mucosa tissues, which are the tissues lining the openings in the body. They represent about 1% of all white blood cells in the body. Allergic reactions are caused by oversensitive basophils. It has been very difficult for most laboratories to obtain basophils in peripheral blood is low (<1%) and they share physiochemical properties with other blood cells.

(iv) Monocyte

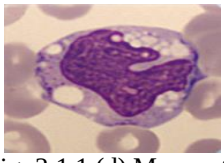

Fig: 2.1.1 (d) Monocyte

Description- Monocytes are normally greater than the leucocytes. In the bone marrow, the ancestors of the monocytes, monoblasts, promonocytes [7] are very tough to

differentiate from myeloblasts. Monocytes are present in the bone marrow for very short time. After 20-40 hours they get matured and perform their duties. The diameter of it is 16-20 μm [8].

(v) Lymphocyte

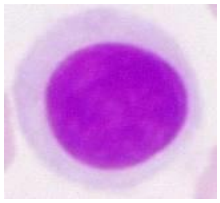

Fig: 2.1.1 (e) Lymphocyte

Description- Lymphocytes are responsible for our body health. They fight against any kind of intruders and infection. This is called are immune system. In the case of any kind of attack, our immune system generates the antigenic specificity to protect our body. The diameter of it is 8-10 μm. The three major types of lymphocyte are T cells, B cells and natural killer cells. Lymphocytes can be identified by their large nucleus. The genesis of lymphocytes is also known as lymphopoiesis. Microscopically, in a Wright's stained peripheral blood smear, a normal lymphocyte has a large, dark-staining nucleus with little to no eosinophilic cytoplasm.

IV. PURPOSE OF WBC COUNT

Generally doctors prescribe complete blood count and examine WBC count. Doctor might recommend WBC count, in case of regular body aches, chills, fever or headaches. Several unknown ailments of human body can be detected via WBC count and notify doctors to undiagnosed medical situations like immune deficiencies, autoimmune diseases or blood disorders. This test also helps doctors monitor the effectiveness of chemotherapy or radiation treatment in cancer patients. Abnormal test results are classified by numbers that are higher and lower than this range. Significantly, age also influence the number of WBCs. Infants have higher count than adults. The irregular WBC count can detect blood infection or other medical condition.

V. LITERATURE REVIEW

Zhu, Xiaofan et al., 2014 [9] aimed at essential systems biology approach to suppose gene supervisory networks of leukaemia related markers. Consequences demonstrated the efficacy of a systems ecosystem approach to make simpler composite genetic interactions without losing significant biological data of the genes. Key indicators that inter-connected other leukaemia associated markers were identified.

Chaitali Raje et al., 2014 [10] proposed system was on microscopic images to detect Leukaemia. The first and fast identification of Leukaemia greatly aids in provided that the suitable treatment. Personalize segmentation is complete using Statistical restriction such as mean, model deviation which separates white blood cells since other blood components i.e. erythrocytes and platelets. Geometrical structures such as area; perimeter of the white blood cell nucleus is investigated for diagnostic prediction of Leukaemia.

Mashiat Fatma et al., 2014 [11] proposed a technique for correct and quick classification of leukaemia pictures & cataloguing them into their personally types. For this, different features are extracted from the input images and then based on these geographies a data set for the input images were created. This data set is then utilized as input data to a neural network for exercise purposes. This neural network had designed & created to categorize the pictures according to their equivalent leukaemia type.

Le Kang, et al., 2015 [12] proposed an approach that combined the smallest amount absolute shrinkage & selection operator & heat map revelation to detect potential biomarkers from a arithmetical perspective. In the research, they firstly classify our sample data into two classes: gene data from blood samples of usual donors & that of stained patients. Then apply the LASSO on the sample data for feature assortment & dimension decrease to identify possible biomarkers.

Van-Nhan TRAN et al., 2016 [13] developed an automate method for the nuclei and cytoplasm detection from the blood cells images that are captured as microscope images. In contrast to other methods that focus on identifying the nuclei, they proposed a method based on the colour conversion, intensity threshold and gradient magnitude.

Shrutika Mahajan 2014 [14] proposed framework utilizes highlights of minuscule pictures by analyzing changes in surface, geometry, shading and factual investigation of pictures. These progressions will be utilized as a classifier input. The exhibited strategy indicates how powerful a programmed morphological technique to recognize the Acute Lymphocytic Leukaemia (ALL) by magnifying lens pictures of blood tests. At first, the framework individuates the leucocytes show in others platelets, after that it perceives the lymphocyte (cells that causes intense leukaemia), assessment with respect to files from those cells is done lastly characterization for the nearness of the leukaemia is finished.

VI. SEGMENTATION TECHNIQUES FOR LEUKAEMIA DETECTION

Several researchers worked on varied segmentation algorithms but appropriate algorithm is yet to be discovered. A major challenge of developing a single and unified approach of image segmentation, which can be used for all types of images. Multiple segmentation techniques available, which can be used individually or integrated with others [11]. Those techniques are categorized as:

4.1 Edge Based Segmentation- Edges of objects in an image are identified that are assumed to be the objects' boundaries. A segmentation technique based on extracting the region of interest from a larger image around thresholder cell nuclei. A shape based approach is proposed to extract

thin structures like lines and sheets from 3D biomedical images.

4.2 Region Based Segmentation- The objective of this method is to group pixels into regions that share similar characteristics. The major drawback of this method is that it may lead to failure if the definition given for region uniformity tends to be too strict. Local thresholding is effective when the gradient effect is small with respect to the chosen sub image size.

4.3 Threshold Based Segmentation- Such technique is commonly used for segmentation. Thresholding maps a grey valued image to a binary image. Many algorithms exist to find the optimum threshold value.

4.4 Clustering Based Segmentation- Clustering is an attempt to measure points or patterns that are grouped together. This technique is commonly applied to data of *n* dimension, where, n is an arbitrary number which can be two, three or more. Clustering technique is best suited for sparse type of images. This technique includes methods like k-means, fuzzy c-means, etc.

4.5 Morphological Watershed Based Segmentation- This method is applied when mathematical morphology needs to be applied. The algorithm considers any gray image as topographic surface. The surface is flooded from its minima and water is prevented from coming out of multiple sources. This leads to division of image in two sets, watershed lines and catchment basins.

4.6 Neural Network Segmentation- Generally, neural network is used for classification purposes, however it can be used for segmentation as well. In general, a small area (of an image), is processed using what we call artificial neural network/s. examples are perceptron, kohonen map etc.

VII. CONCLUSION

Different techniques used in various phases of Leukaemia detection were discussed. In this paper, different segmentation techniques are classified and discusses. Image segmentation has evolved as a basic technique for image processing and computer vision. We are presenting the Disease of Leukaemia or called growth of platelet. Leukaemia is a malady or kind of blood tumour, which portrayed by a strange amassing of white platelets (leukocytes) and its antecedents which impair its capacity of battling contamination. Early discovery of the ailment is fundamental for legitimate treatment administration Several Types and signs and side effects of leukaemia. We've likewise clarified the white platelets, its writes and motivation behind WBC tally. A few past looks into were likewise audited to show signs of improvement see about leukaemia in detail. Division is by and large known as dividing of a picture is one of the natural parts of any picture preparing procedure. We have exhibited general audit division strategies utilized for Leukaemia recognition.

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