Chapter 15

Improved Lymphocyte Image Segmentation Using Near Sets for ALL Detection

Shiwangi Chhawchharia
Vellore Institute of Technology, India

Subrajeet Mohapatra
Birla Institute of Technology Mesra, India

Gadadhar Sahoo
Birla Institute of Technology Mesra, India

ABSTRACT

Light microscopic examination of peripheral blood smear is considered vital for diagnosis of various hematological disorders. The objective of this paper is to develop a fast, robust and simple framework for blood microscopic image segmentation which can assist in automated detection of hematological diseases i.e. acute lymphoblastic leukemia (ALL). A near set based clustering approach is followed for color based segmentation of lymphocyte blood image. Here, a novel distance measure using near sets has been introduced. This improved nearness distance measure has been used in a clustering framework for achieving accurate lymphocyte image segmentation. The nearness measure determines the degree to which two pixels resemble each other based on a defined probe function. It is essential as image segmentation is considered here as a colour based pixel clustering problem. Lymphocyte image segmentation algorithm developed here labels each pixel into nucleus, cytoplasm or background region based on the nearness measure.

1. INTRODUCTION

Cellular components of the blood (erythrocyte, leukocytes, and platelets) are important for medical diagnosis of various hematological disorders. These blood cells which are easily reachable are indicators of disturbances or degradation in their organs of origin which are more difficult to analyze (being less accessible). Thus, changes in the features of blood cells can easily be studied and
important inferences can be drawn about various hematological abnormalities. Any disorder detected in erythrocytes, leukocytes or platelets is considered as a sign of critical condition which needs immediate attention. This paper would help in the recognition of such deformities of leukocytes or white blood cells (WBC).

Deformities in WBC are usually neoplastic or non-neoplastic. One of the potentially fatal WBC disorder is leukemia. It is a neoplastic disorder and considered as our subject of study.

Leukemia is neoplastic proliferations of hemopoietic cells in human body. It is a type of hematological disease. This malignant transformation of cells can be attributed to specific genetic changes. This results in formation of clone of leukemia cells or cancerous tumor of white blood cells. Leukemia is a condition where number of myeloid or lymphoid blasts increases causing a hematological malignancy. It can be acute or chronic depending on the severity of the disease. Leukemia can be categorized on the basis of morphologic findings, genetic abnormalities, putative etiology, and cell of origin, immunophenotypic qualities, and clinical characteristics. Thus its classification is quite complicated. However, French, American, British (FAB) classification and World Health Organization (WHO) classification are two protocols for leukemia categorization which are widely applied (Trachuk, 2007). Both fundamentally divide leukemia’s into myeloid and lymphoid types, depending on the origin of the blast cell. In the present work we consider acute lymphoblastic leukemia (ALL) as our research focus.

Advanced techniques like flow cytometer, immunophenotyping, molecular probing etc, are present but they are not economic choice for initial screening of leukemia patients as microscopic examination of blood slides. The disadvantage of manual examination of blood slides is that it is subject to human error and the count is based on a much smaller sample size. Thus automated framework would help diagnosing patients with more accuracy. They will support medical clinicians in providing prediction of acute lymphoblastic leukemia in a simple and robust way. The benefit of the automated system is that it reduces the risk of wrong diagnoses, provides much quicker diagnoses for patients’ conditions, and removes wavering opinions of doctors.

Image segmentation of peripheral blood smear for differential blood count is vital in today’s medical industry as it helps in correctly analyzing the conditions of healthy and unhealthy patients. The normality and abnormality conditions of WBC provide hematologists with a great amount of useful data and knowledge about a patient’s condition. However, high performance measure is a requirement in automated blood image segmentation for accurate hematological disease detection. There are various segmentation algorithms which provide high efficiency with different kinds of images and as there is no standard segmentation process, specialized process especially for segmentation of blood image can be developed.

Clustering is a classification technique. Given a vector of N measurements describing each pixel or group of pixels (i.e., region) in an image, a similarity of the measurement vectors and therefore their clustering in the N-dimensional measurement space implies similarity of the corresponding pixels or pixel groups. Therefore, clustering in measurement space may be an indicator of similarity of image regions, and may be used for segmentation purposes.

The vector of measurements describes some useful image feature and thus is also known as a feature vector. Similarity between image regions or pixels implies clustering (small separation distances) in the feature space. Clustering methods were some of the earliest data segmentation techniques to be developed (see Figure 1. Clusters)

1.1. Similar Data Points Grouped Together into Clusters

Most popular clustering algorithms suffer from two major drawbacks
16 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the product's webpage:  
www.igi-global.com/chapter/improved-lymphocyte-image-segmentation-using-near-sets-for-all-detection/141641?camid=4v1

www.igi-global.com/e-resources/library-recommendation/?id=77

Related Content

3D Scanner, State of the Art  
www.igi-global.com/chapter/scanner-state-art/60280?camid=4v1a

Fuzzy Shape of Objects in Images with Similarity Measure for Image Retrieval Applications  
www.igi-global.com/article/fuzzy-shape-of-objects-in-images-with-similarity-measure-for-image-retrieval-applications/159807?camid=4v1a

Computational Intelligence for Pathological Issues in Precision Agriculture  
www.igi-global.com/chapter/computational-intelligence-pathological-issues-precision/77577?camid=4v1a

Discriminative Moment Feature Descriptors for Face Recognition  
www.igi-global.com/article/discriminative-moment-feature-descriptors-for-face-recognition/159808?camid=4v1a