Academic Science

International Journal of Innovations & Advancement in Computer Science
IJIACS
ISSN 2347 – 8616
Volume 6, Issue 4
April 2017

Automatic Detection of Blood Cancer in Microscopic Images: A Review

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ABSTRACT
Blood cancer mainly attacks the blood, bone marrow or lymphatic system. It is diagnosed with a blood test in which presence of white blood cells is counted by the hematologists which is a very time consuming and tedious and mainly leads to late detection Therefore need of automatic detection is required to overcome the limitations of manual reviewed process and early and fast detection. So, this letter provides a review on various automatic detection methods for blood cancer developed with the help of image processing techniques. Also provides pros and cons of existing methods with their proper accuracy.

Introduction:
Body fluid in humans that deliver nutrients and oxygen to the cells is known as blood. Blood cells are produced by blood stem cells which consist of two parts i.e. myeloid stem cells (produces red blood cells and platelets) and lymphoid stem cells (produces white blood cells. Red blood cells(RBCs) which carries oxygen to all the body parts and also known as erythrocytes, White blood cells(WBCs) which helps in fighting against infection and also known as leukocytes or leucocytes and Platelets which helps from blood clots to slow or stop bleeding .Formation, growth, function and death of these cells is controlled by bone marrow. Each bone is having a thin material inside it, known as bone marrow. In certain instance, growth of white blood cells is disturbed which results in generation of leukemia cells. Count of WBCs will be more compare to RBCs and platelets because leukemia cells generate copies of themselves and will not die when they became old and damaged and keep on growing which results in low level of RBCs and platelets and make it difficult to get oxygen to the body, fight against infections and control bleeding.

Types of leukemia: classification of leukemia is done on the basis of how fast it develops and gets worse:

1. **Acute leukemia**: develops suddenly means number of leukemia cells increases rapidly and don't perform the work of normal white blood cells and persons with this category disease feel very tired and get infections easily because normal red blood cells and platelets are not functioning properly due to large count of leukemia cells.
2. **Chronic leukemia**: usually develops slowly as compare to acute leukemia. Initially infected white blood cells perform same functioning as normal WBCs but if not controlled at early stage then it turns as acute leukemia and become severe.

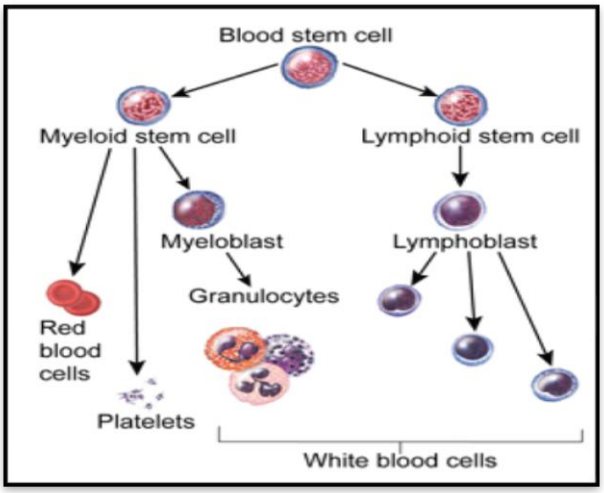

Figure 1: shows components of blood stem cells [12]

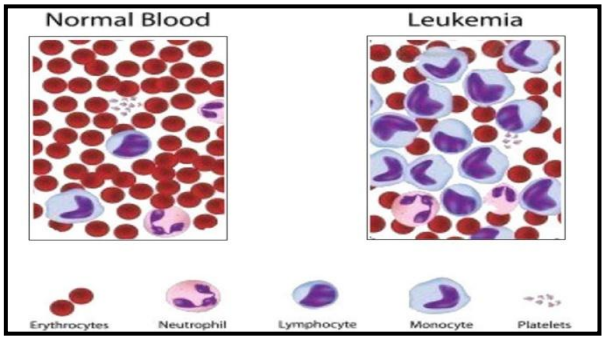

Figure 2: Shows normal blood cells and leukemia cells [13]

Leukemia can be sub classified based upon the kind of white blood cells.

Table1:Types of Leukemia

Types	Description
Acute Lymphocytic Leukemia (ALL)	It develops very quickly affecting lymphoid stem cells and mostly occurs in teen age childerns.
Acute Myeloid Leukemia (AML)	It develps verly quickly affecting myeloid stem cells and mainly occurs in adults having age 65 or more.
ChronicMyeloid leukemia (CLL)	affects myeloid cells and initially starts slowly and most commonly found in adults more than age of 65 as compare to childerns.
Chronic lymphocytic leukemia (CLL)	affects lymphoid stem cells but slowly and increase white blood cells works like normal WBCs and mostly found in adults , never occur in childerns.

General Research Methodology: After studying the literature, we review following general methodology for the automatic blood cancer detection.

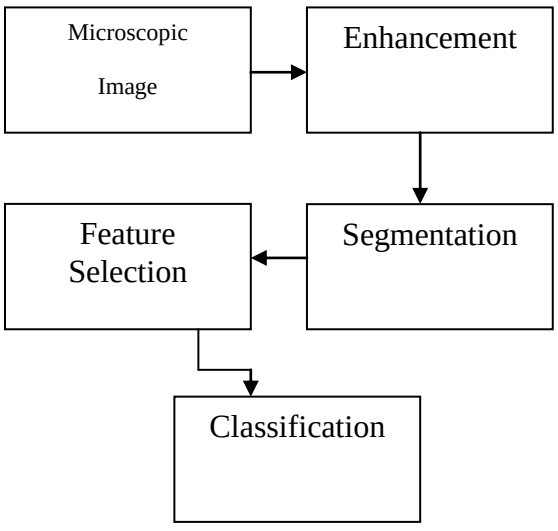

Figure 3: Shows sequence of steps for automatic detection.

Microscopic images: Cancer infected blood cell images is collected from the authorized laboratory or from any government hospital in order to carry out the further processing.

Ehnancement: Images may contain some artificats initally, so there is a need to ehnace the taken images. Mostly images contain some sort of noise, so before proceeding further these artificatts should be removed with the help of image ehnacemnet techniques like to remove noise use various kinds of operators i.e. prewitt and sobel, canny etc.

Segmentation: Segmentation is a process of partitioning an image into sub parts, so that proper each and every area is scanned properly. Microsopic images consist of red blood cells, white blood cells and platelets. But in order to detect the presence of blood cancer we only required to count the number of white blood cells. So with the help of segmentation process we will separated the white blood cells from red blood cells and platelets. Various techniques used for segmenation are region based segmenation, k-means Zack algorithm, morphological operation, gradient magnitude and watershed transform etc.

Feature Selection: In this phase we try to extract some of the features from the processed image. Feature extraction is the process of converting the image into data so that we can check these values with the standard values and finally we can differentiate between the cancerous and non-cancerous data. Some of the features which are necessary to be calculated are listed below.

- Color Features– The mean color values of the grey images are acquired.
- Geometric Features – The perimeter, radius, area, rectangularity, compactness, convexity, concavity, symmetry, elongation, eccentricity, solidity are obtained.
- Texture Features – The entropy, energy, homogeneity, correlation are obtained.
- Statistical Features – The skew ness, mean, variance and gradient matrix are obtained.

Classifier: In this final phase, the extracted features are used to provide the final answer. All feature extracted are listed into the different columns with their values. When we give any image as an input to the proposed system then we first calculate the feature values. The values of the test image features are checked with the previously calculated values Based on the values of the input image the classifier classifies that test image into either infected or not infected class

Related Work

Bhagyashri G Patil et.al.[], Cancer infected cells are detected using two methods of segmentation i.e thresholding and watershed. The segmentation accuracy using thresholding and watershedtechniques are 81.24% and 85.27% respectively. From theresults watershed segmentation of biomedical image has better accuracy and quality.

Selen Ayas et.al [2] developed novel approach for segmentation of microscopic image for detection of tuberculosis bacteria based on soft computing algorithm firefly to obtain threshold value microscopic images. Performance ratio is nearly 95% by using this novel approach.

Chaitali et.al [3] in this paper leukemia cells were detected by using the process of segmentation. Segmentation is done by using statistical parameters that is mean and standard deviation. Tools used for the process of segmentation are Matlab and Labview using large number of images infected by blood cancer. Labview provide better results as compare to matlab.

S.S.Savkare et.al [4] proposed a method for segmenting blood cells from microscopic blood cell images in order to detect various diseases like malaria, anemia and blood cancer.To remove unwanted artifacts preprocessing is done by using median filter and laplacian filter. To differentiate red blood cells, white blood cells and platelets segmentation is done by using k-means clustering. Some cells get over segmented, so separation of overlapping cells is done by using morphological dilation followed by erosion of over segmented objects

D.Goutam et.al [5] proposed a new method for classification of acute myelogenous leukemia in blood microscopic images using supervised SVM classifier. This type of cancer mainly occurs in adults. Initially preprocessing is done by using median filters to remove noise and other artificats. After that segmentation is done to separate WBCs using k means clustering and next stage consist of feature extraction using local directional pattern. Finally SVM classifier is used for complete separation of WBCs. Results are evaluated by using parameters like precision, sensitivity, and obtain 98% accuracy.

Rakhibull Ahasan [6] propose algorithm for segmentation of white blood cells taken from microscopic images of strained peripheral blood film during leukemia and normal condition by using color space conversion, color thresholding, filtering, marker controlled watershed and different morphological operations. Result accuracy is 88.

Ashwini Rejintal et.al [7] detect presence of Leukemia by using K-means segmentation method taking value of k=3, followed by feature extraction in order to find out the proper size and shape of the cancer cell and the area .Gray level co-occurrence matrix (GLCM) and gray level difference method (GLDH) are used to find the energy, contrast, auto correlation, entropy, variance etc. Finally Cancerous cell is detected by using the SVM classifier.

Sonali Mishra et.al [8] proposed algorithm for classification of microscopic images by using discrete cosine transformation for detection of acute lymphoblastic leukemia, a kind of blood cancer. Discrete cosine transformation coefficient is taken as the feature for the classification process. Extracted features will be approximately 90.Finally SVM classifier is used to classify the images as normal and abnormal. Results show accuracy up to 89 %.

Yang Song et.al [9] to overcome feature of overlapping between cell nuclei and background pixels which leads to misclassification, a novel method for automatic cell nucleus segmentation was proposed. Two level approaches are designed to enhance the power of intensity features. Proposed method was evaluated on three different 2-D microscopy images and provides better results as compare to state art methods.

Gurpreet singh et.al [10] presented a review work for detection of leukemia cancer in medical images. Various techniques used for leukemia detection and prevention are artificial neural network, linear dependent analysis, self-organizing map, SVM and genetic algorithms.

Krishna kumarjha et.al [11] presented a review paper on detection of blood cancer in microscopic images of human blood samples. Segmentation is used for detection mainly by using thresholding, watershed, Zack algorithm, k-nearest neighbors, k-means clustering and neural networks

Conclusion and Future Work

In this paper various techniques used for detection of blood cancer automatically are reviewed. As blood cancer is one of the most dangerous disease caused due to exceeds in the number of white blood cells. Due to lack of

proper traetment it could be a fatal disease. So it must be diagnosis early.

For future work, use of soft computing will be considered as a classification tool. Soft computing is based on nature insipred techniques, so it also provide most prominent results.

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