Review on Image Segmentation Techniques to Detect Outliers in Blood Samples

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Abstract --- *A person's health is determined by complete blood count which consisting of white blood cells, the red blood cells and platelets. Leukemia occurs when a lot of abnormal white blood cells are produced by bone marrow thereby leading to cancer. In laboratory, blood cell counting often produces inaccurate and unreliable results since usage of hemocytometer or microscope is laborious and time consuming task. Images are used as they are cheap and do not require expensive testing and lab equipment. Image processing is a strategy to extract useful characteristics from original image through different stages. The primary stages of noise or outlier removal are image acquisition, preprocessing, image enhancement, image segmentation, feature extraction. Image Segmentation is a process of identifying blood cell types regardless of their irregular shapes, sizes, and orientation. This survey reviews on the different image segmentation strategies adopted by researchers in detecting leukemia from blood microscopic image to boost the clustering performance thereby eliminating noise in cell image.*

Keywords --- *Leukemia, Image segmentation, Anomaly detection, Clustering algorithms*

I. INTRODUCTION

Leukemia is a cancer in blood that is repairable when it is identified and cared at right time otherwise it can endanger human life. In Leukemia, a group of malignant disorders affects the blood and blood forming tissues of Bone marrow, Lymph system and Spleen**.** If there are abnormalities in this count, a study of morphological bone marrow smear analysis is done to confirm the presence of leukemic cells. Leukemia is a cancer of the lymphoblast (white blood cells, which fight infection) is shown is Fig.1.

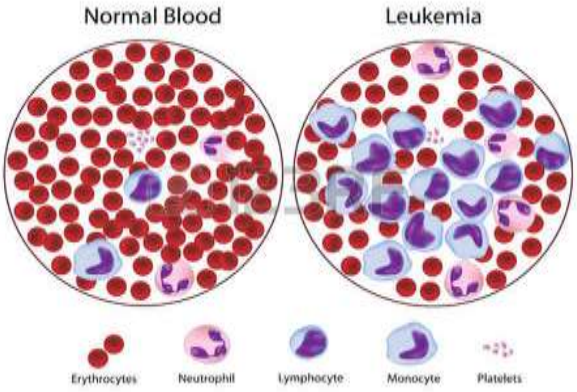

Fig.1 Leukemia Blood Sample differentiation from Normal Blood Sample

White blood cells are the most common type of blood cell to become cancer is shown in Fig.2. But red blood cells (cells that carry oxygen from the lungs to the rest of the body) and platelets (cells that clot the blood) may also become cancer. Leukemia is curable if it is detected and treated in at early stage. Leukemia occurs most often in adults older than 55 years, but it is also the most common cancer in children younger than 15 years.

Leukemia can be either acute or chronic.

a) Acute (Dormant) leukemia is a fast-growing cancer that usually gets worse quickly.

b) Chronic (Active) leukemia is a slower-growing cancer that gets worse slowly over time.

c) Acute myeloid leukemia (AML)

i. Characterized by the rapid growth of abnormal WBC, also known as "Auer rods".

ii. Affects around 2600 adults a year and over 65 can get it.

iii. It is extremely rare in teenagers.

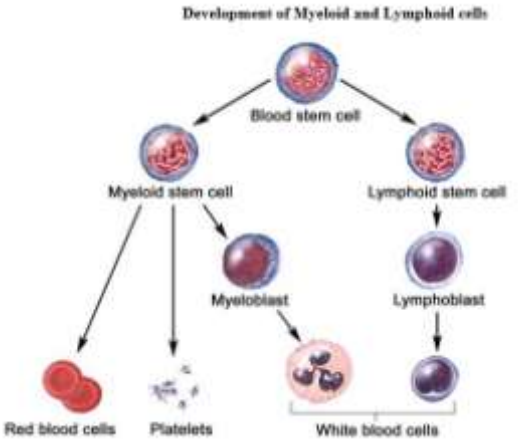

Fig.2 Classification of Myeloid and Lymphoid cells

d) Acute lymphoblastic leukemia (ALL)
   i. This type is the most common type.
   ii. Usually affects children between 2 – 10 years.

e) Chronic myeloid leukemia (CML)
   i. This type is a rare condition affects all.
   ii. Usually affects people aged above 40years.

f) Chronic lymphocytic leukemia (CLL)
   i. This type is also the most common.
   ii. Occurs at all ages, but most common for adults aged between 40 and 60.

Microscopic pictures are visually reviewed by hematologists or pathologists to identify whether the immature cell is cancerous or not and also to identify the type of leukemia. The differentiation is shown in Fig.3. Manual cytometric test consideration usually time consuming, less accuracy and extremely affordable in its cost. To overcome this, machine learning algorithm can be used to improve accuracy.

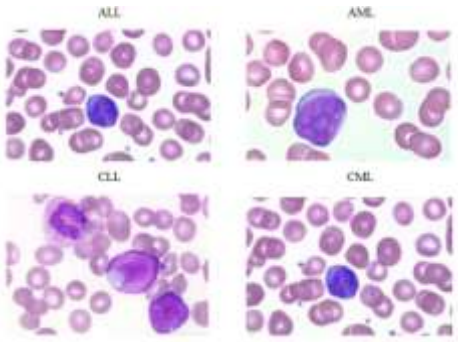

Fig.3 Types of Leukemia cell

1.1 Image Processing

Digital Image Processing is a process of taking an image as an input; perform some mathematical operation on it, in order to manipulate the cell image which includes enhancing, reducing, rotating etc. or extracting some useful information from it and producing the desired output..The Steps involved to process image are shown in Fig 4. In this paper, image processing allows various techniques, methods and a wider range of algorithms to be applied to the input images and can avoid distorted noise occurs during the process.

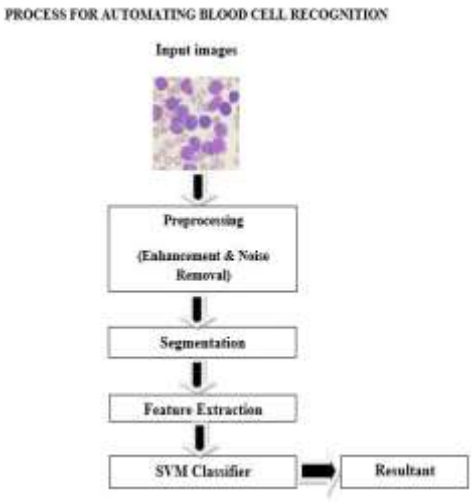

Fig.4 Process for Automating Blood Cell Recognition

Main components of image processing

a) *Image Acquisition*: It deals with capturing images or samples.

b) *Image Enhancement*: It deals with the improvement of quality of images.

c) *Image Representation*: It deals with different ways in which image can be represented mathematically, graphically, and statistically.

d) *Image Transformation*: It is used to transform the input image from one domain into another

e) *Image Restoration*: It deals with the analysis and modeling of different types of noise mixed in images.

f) Color image processing: Various color spaces and formats are converted in it.

g) *Image compression*: It is used to reduce the size of image or reduce redundancy without any significant change in the inherent content of the image.

h) *Morphological image processing*: It is used to represent or convert into suitable forms so that edges can be easily recovered. These operations are generally used with image segmentation.

i) Image segmentation, representation and description: The selected region of interests can be extracted and various boundaries, edges and other similar information could be obtained.

j) *Object recognition*: It deals with the pattern recognition and matching.

1.2. Related Works

A microscopic image of the blood set can be analyzed and the cancer cells can be detected. The analysis may be done by different stages such as the Image Pre-processing, Image Enhancement, Image Clustering, Image Segmentation, Image Classification, Fuzzy Rule Based Detection.

A. Image Pre-processing Stage

Image pre-processing generally defines the improvement in the data-sets that are collected. This stage removes the unwanted pixel values and selects the pixels from the image that are needed for the detection and enhances them for a better result. Removing low-frequency background noise, normalizing the intensity of the individual particles images, removing reflections, and masking portions of images are the commonly carried out in the pre-processing stage.

B. Image Enhancement Stage

Image Enhancement is one of the most important and difficult techniques in image research. The aim of image enhancement is to improve the visual appearance of an image, and to provide a "better transform representation for future automated image. Image Enhancement techniques which improves the quality (clarity) of images for human viewing, removing blurring and noise, increasing contrast, and revealing details.

Image enhancement can be classified into two approaches Spatial domain enhancement and Frequency domain enhancement

I. Spatial domain enhancement

Spatial domain techniques directly deal with the image pixels. The pixel values are manipulated to achieve desired enhancement. Spatial domain techniques like the logarithmic transforms, power law transforms, histogram equalization are based on the direct manipulation of the pixels in the image. Spatial techniques are particularly useful for directly altering the gray level values of individual pixels and hence the overall contrast of the entire image.

The approaches can be classified into two categories: Point Processing operation (Intensity transformation function) and Spatial filter operations. Point processing operations (Intensity transformation function) is the simplest spatial domain operation as operations are performed on single pixel only. Pixel values of the processed image depend on pixel values of original image.

II. Frequency domain enhancement

Frequency domain techniques are based on the manipulation of the orthogonal transform of the image rather than the image itself. Frequency domain techniques are suited for processing the image according to the frequency content. The principle behind the frequency domain methods of image enhancement consists of computing a 2-D discrete unitary transform of the image

The approaches can be classified into three categories: Image Smoothing, Image Sharpening, Periodic Noise reduction by frequency domain filtering.

C. Image Clustering Stage

Clustering is the classification of objects into different clusters. It is most commonly and efficient method that to when considering on segmentation aspects. Some of the clustering techniques such as K-means, Fuzzy C-means, Subtractive technique, Expectation maximization algorithm etc. The different stages of clustering task involved are represented in Fig 5.

In this paper, we focus on image clustering considering areas of K-means clustering techniques.

K-means clustering algorithm is one of the most commonly used clustering algorithms. In K-means clustering, it partitions a set of data into a k number group of data. Each cluster in the partition is defined by its data member and by its cluster centroid. The centroid can be defined as the point in which the sum of distances from all the objects in that cluster is minimized. Therefore, K-means is an iterative algorithm in such a way that it minimizes the sum of distances from each object to its cluster centroid, over all clusters. In this paper, K-means is determined by unsupervised grouping method where the information focuses into different classes. Generally three steps are involved in K-means:

a) Compute the mean of each cluster.

b) Compute the distance of each point from each cluster by computing its distance from the corresponding cluster mean.

c) Assign each point to the cluster nearest to it and repeat until sum of squared within group errors.

Process for image to be clustered in K-means:

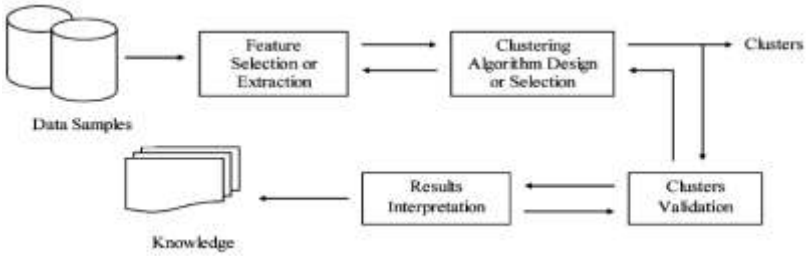

Fig.5. Stages of Clustering task

a) Blood Cell is taken as an Input Image and each image is treated to be pixel form and feature space is considered to be RGB.

b) Each data points are collected with similar colors with grouping together using K-means clustering methods and the minimum distance is calculated to measure the Euclidean distance.

c) Mean of the clusters is taken that is mean color in each cluster is calculated and remapped onto the image.

D. Image Segmentation Stage

Image Segmentation refers to the process of partitioning a digital image into multiple number of segments. Image segmentation is typically used to locate objects and boundaries in image. Image segmentation helps in knowing the precise size and shape of the cancer cell and the area parameters.

In Segmentation, various techniques used such as thresholding, edge detection, pixel clustering and growing regions to extract nucleus and cytoplasm of leukocytes.

Image segmentation approach, based on two properties of an image, is divided into two categories:

a) Discontinuities based: In this category, subdivision of images are carried out on the basis of abrupt changes in the intensity of gray levels of an image. Our focus is primarily based on identification of isolated points, lines and edges. This include image segmentation algorithms like edge detection.

b) Similarities based: In this category, subdivision of images are carried out on the basis of similarities in intensity or grey levels of an image. Our focus here is on identification of similar points, lines and edges. This includes image segmentation algorithms like thresholding, region growing, region splitting and merging. The condition for different regions may be rapid transition of intensity. So those pixels are extracted and linked together to form a closed boundary.

c) Edge Detection: Edge detection method detects the edge or pixels between different regions. The condition for different regions may be rapid transition of intensity. So those pixels are extracted and linked together to form a closed boundary.

d) Bayesian based segmentation: Bayesian method is used for the classification purpose and it is works by considering probability in the image to construct models based on the probability.There are different approaches in Bayesian method like Markov Random Field (MRF), Expectation Maximization (EM).

e) Thresholding based segmentation: Thresholding is the simplest and fast image segmentation method. It tries to differentiate between the image background and image foreground. A thresholding procedure uses the intensity histogram and attempts to determine the intensity values called threshold value and these threshold values differentiate the desired classes. Thresholding method is sensitive to noise and intensity inhomogeneity.

f) Region based segmentation

i. *Region growing*: Region growing is a method for extracting a connected regions of the image which consists of group of pixels with similar intensities. In this method, a point is initially defined which is known as seed point. Then all the points which are connected to seed point having same intensity as that of seed point are selected and are added to the growing regions. This procedure is repeated until no more pixel can been added to the region.

ii. *Region Splitting*: Rather than choosing initial seed as in case of region growing, image can be divided into unconnected regions and then merge again based on some condition. That means it is consists of two steps - splitting and merging step. Quad tree method is generally used in splitting.

g) *Neural Network-based segmentation*

In this algorithm, an image is firstly mapped into a neural network where every neuron represents a pixel. The neural network is trained with training sample set in order to determine the connection and weights between nodes. Then the new images are segmented with trained neural network. Neural network segmentation includes two important steps:

i. Feature extraction - This step determines the input data of neural network. Some important features from images are extracted that will help in image segmentation

ii. Image segmentation - In this step the image is segmented based on the features extracted from the images

Neural network based on segmentation have three basic characteristics:

i. Fast computing and highly parallel computing ability makes it suitable for real time application.

ii. Improve segmentation results when the data deviated from a normal situation.

iii. High robustness makes it immune to noise.

h) *K-mean Segmentation* is used for segmentation when we apply for feature extraction after that we have connected it to classifier to get the desired output whether the blood cells is cancerous or not. The flow chart for K-mean segmentation is shown in Fig 6. K-means algorithm is stated as the best algorithm which is generally used for the differentiation purpose.

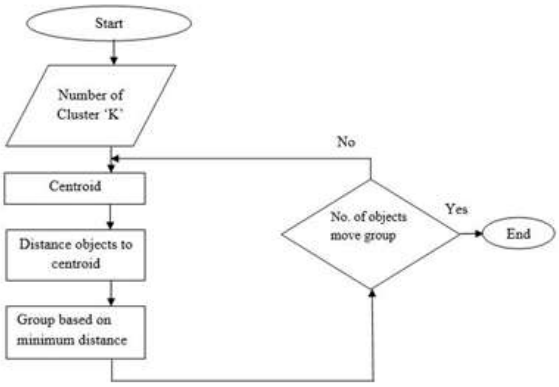

Fig.6. Flow chart for K-Means image segmentation

F. Image Classification Stage

Classification method use data with known labels to partition the image feature space. Then this feature space is further divided into different regions depending upon the function. This classification method can be both supervised and unsupervised. In supervised, the image is trained and it is manually segmented and it is used further for the automatic segmentation of new images.

a) Support vector machine is a classifier in which labeling the parts and segmenting it out. SVM is built up to minimize error in empirical classification and maximize the geometric margin. SVM classifier classifies the cells between two classes by drawing a hyper-plane and constructing the maximum distance of the nearest cell to the hyper-plane. Finally, SVM classifier shows the accuracy with help of the data in the knowledge base is used for classification, whether the cells are cancerous or not.

b) Fuzzy Rule based detection system stage

Fuzzy logic is generally a multi-valued logic which allows the intermediate values to define results such ah yes or no, true or false, black or white, etc. In this paper, it predicts the resultant by the given input cell images whether it is cancerous or not. If the cell is cancerous then its type is found among acute myeloid leukemia, acute lymphoblastic leukemia, chronic myeloid leukemia, and chronic lymphocytic leukemia.

II. LITERATURE REVIEW

K.S. Fu et al. [10] proposed many image segmentation techniques such as characteristic feature thresholding or clustering, edge detection and region extraction. The approach combines spatial and semantic information with edge detection technique and thresholding or clustering technique to improve image segmentation performance. The comparison of different authors proposals to improve segmentation accuracy is discussed in Table 1.

Robert M. Haralick et al. [9] proposed strategy for various image segmentation techniques with respect to homogeneous regions. Many techniques such as measurement space guided spatial clustering, single linkage region growing schemes, hybrid linkage region growing schemes, centroid linkage region growing schemes, spatial clustering schemes and split & merge schemes are adopted .

Inpakala Simon et al. [11] proposed strategy for automated image analysis system for detecting boundaries of live prostate cancer cells of Hoffman and DIC microscopy images using segmentation algorithm. Morphometric measurements were derived from computer-determined cell boundaries and compared with the same measurements derived from manually traced cell boundaries efficiently eliminating intra observer variation.

Daniela Mayumi Ushizima et al. [30] proposed multiclass strategy for investigate and compare the results using Support Vector Machines (SVMs) classifiers to recognize WBC for future leukemia diagnosis. However, SVM performed better using the full set with accuracy for the reduced set when compared to Naïve Bayes.

R. Adollah et al. [18] proposed strategy to review some of the general segmentation methods that have found application in classification in blood cell using various image processing techniques.

Madhloom HT et al. [3] proposed strategy that the white blood cell nuclei can be detected by using some image arithmetic operation and Image threshold operation. M. Ghosh et al. [6] proposed strategy by introducing an automated approach to leukocyte recognition using fuzzy divergence based segmentation scheme and modified thresholding techniques. Among various fuzzy membership functions, Gamma, Gaussian and Cauchy functions are considered for exploratory study and analysis. Cauchy provides better segmentation particularly for leukocyte recognition in comparison with others. Aimi Salihah et al. [21] proposed strategy for Acute

Myelogenous Leukemia (AML) detection by using the contrast enhancement WBC technique and to have better improvement in result, HSI color space technique is used to stretching the image visibility.

N.H.Abd Halim et al. [22] proposed an approach for early detection of the disease is necessary for proper treatment. Image enhancement is very important to increase the visual aspect of malignant cells. Global contrast stretching and segmentation based on HIS color space will be used to improve the image quality for ALL and AML respectively. Subrajeet Mohapatra et al. [24] proposed strategy that WBCs nucleus segmentation of stained 108 blood smear images are detected and required features are extracted using image processing techniques such as Hausdorff dimension and contour signature. Techniques such as Fluorescence in Situ Hybridization (FISH), immunophenotyping, cytogenetic analysis and cytochemistry are also employed for specific leukemia detection. Two stages color segmentation strategy is employed for segregating leukocytes or WBC from other blood components using Fuzzy rule technique and 93% accuracy is obtained.

Ms.Chinki Chandhok et al. [12] proposed an approach for color–based segmentation by applying K-means algorithm technique for homogenous regions with respect to texture and color.In 2012, Fauziah Kasmin, Anton Satria Prabuwono, Azizi Abdullah [26] states to describe the study of developing a detection of leukemia types using microscopic blood sample images and can be detected and diagnosed at earlier stage. The system will use features in microscopic images and examine changes on texture, geometry, color and statistical analysis. Here, Reinforcement Learning is proposed strategy to classify types of leukemia.

S.Jagadeesh et al. [1] proposed strategy that to generate the infected cells and describe which types of leukemia by various segmentation techniques includes Watershed algorithm, determination of distinct cells, Feature quality, correlation, principal component analysis, support vector machine, statistical and geometrical examination of the cells. S.S. Bedi et al. [8] proposed strategy by various image enhancement technique which would improve a lot in visual appearance of an image using spatial domain methods. Even though enhancement algorithms play a critical role in real-time applications still it is in emerging technique to have better transform representations, adaptive algorithms using Fuzzy Logic and Neural Network.

Chaitali Raje et al. [15] proposed strategy to detection of leukemia in microscopic images using various image processing. It will use features in microscopic images and examine changes in texture, geometry, color and statistical analysis. Otsu's thresholding based produced good segmentation performance and the fully segmented nucleus can be better achieved by using LabVIEW based algorithm because it is less sensitive to input image variations.

II. TABLE 1

S.No.	Techniques	Proposed Algorithm	Researcher	Year
1.	Pre-Processing , Feature Extraction, Watershed Transformation	K-Means Segmentation, SVM Classifier	S.Jagadeesh Dr.E.Nagabhooshanam Dr.S.Venkatachalam	2013
2.	Threshold, Region Based, Edge Detection, Classification, Bayesian	K-Means Clustering, Fuzzy C-Means, Subtractive, DBSCAN	Nameirakpam, Dhanachandra Yambem Jina Chanu	2017
3.	Image Arithmetic Operation, Image Threshold Operation	Correlation Methods, Thresholding Algorithm	Madhloom HT Kareem SA, Ariffin H, Zaidan AA, Alanazi HO, Zaidan BB	2010
4.	Data Mining Techniques	SVM, Classification, ANN, Genetic Algorithm	Pawandeep Arshdeep Singh	2016
5.	Segmentation Techniques	FCM, Histogram Equalization, Edge Detection, Thresholding Algorithm	Rohan Kandwal Ashok Kumar Sanjay Bhargava	2014
6.	Fuzzy Divergence , Gamma And Gaussian Techniques	Adaptive FCM, Gaussian Mixture Model	M. Ghosh, D. Das C. Chakraborty A.K. Ray	2010
7.	Image Segmentation Techniques	Fuzzy-C-Means (FCM), Gaussian Mixture Model (GMM), K-Means	Arti Taneja Dr. Priya Ranjan Dr.Amit Ujjlayan	2015
8.	Spatial Domain And Frequency Domain Enhancement	Histogram Equalization, Fourier Transform, Filter Operations	S.S. Bedi Rati Khandelwal	2013
9.	Clustering , Segmentation Techniques	ISODATA, Image Noise , Histogram	Robert M. Haralick Linda G. Shapiro	1985
10.	Feature Thresholding, Clustering, Edge Detection, Region Extraction	Frequency Filtering , Gradient Operator,	K.S. Fu J.K.Mui	1981

11.	Image Analysis , Feature Extraction, Morphometry	Fourier Transforms, Segmentation Algorithm – Noise Reduction , Unipolar Intensity Transformation , Edge Detection Erosion, Dilation	Inpakala Simon, Charles R. Pound Alan W. Partin James Q. Clemens William A. Christens-Barry	1998
12.	Color- Based Segmentation, Clustering	K – Means Clustering, Lloyd's Algorithm	Ms.Chinki Chandhok, Mrs.Soni Chaturvedi, Dr.A.A Khurshid	2012
13.	Image Enhancement, Morphological Operations , Segmentation	K – Means , Fuzzy C– Means Clustering	G. Nagaraju Dr. P. V. Ramaraju	2015
14.	Color –Based Segmentation , Thresholding, Adaptive Diffusion	K –Mean Algorithm	Sarthak Panda	2015
15.	Image Enhancement, Segmentation, Thresholding, Mathematical Morphology, Labeling(Labview), Histogram Equalization	K-NN Classifier, Statistical Parameters - Mean And Standard Deviation, Otsu's Thresholding	Chaitali Raje Jyoti Rangole	2014
16.	Image Analysis, Classification , Segmentation, Visual Recognition, Feature Extraction	Linear Dependant Analysis(LDA), Artificial Neural Network(ANN),Self-Organizing Maps(SOM), Support Vector Machine(SVM)	Gurpreet Singh, GauravBathla SharanPreetKaur	2016
17.	Image Processing Techniques, Image Analysis, Segmentation, Clustering, Morphological Operations	Color Space Scales, Geometrical Parameters , Texture Features	Shailesh J. Mishra Mrs.A.P.Deshmukh	2015
18.	Image Acquisition, Color Image Segmentation, Image Post – Processing, Image Analysis, Classification, Morphological Components, Watershed Transform, Scale-Space Filtering	Hausdroff Distance , Otsu's Thresholding, Least Square Method, Non-Exclusive RGB Exclusive RGB Segmentation	R. Adollah, M.Y. Mashor, N.F. Mohd Nasir, H. Rosline, H. Mahsin, H. Adilah	2008
19.	Image Processing, Image Segmentation, Image Enhancement, Morphology, Hough Transform, Feature Extraction, Snake Body Detection	K-Means, ANN, SVM, RGB Counting Algorithm	Amruta Pandit, Shrikrishna Kolhar, Pragati Patil	2015
20.	Image Acquisition, Image Enhancement, Image Segmentation, Image Labeling, Detection and Counting, Morphological operation	Factor Threshold, Sobel Edge Masks, Watershed Transform	Deepika N. Patil Uday P. Khot	2015
21.	Image Analysis , Contrast Enhancement , HSI Color Space Segmentation, Sketching Techniques	Canny Edge Detection, Intensity Histogram, Linear Mapping Function,	Aimi Salihah A.N., M.Y.Mashor Nor Hazlyna Harun Azian Azamimi Abdullah H.Rosline	2010
22.	Contrast Enhancement, Global and Contrast Sketching, Segmentation(HSI), Morphological Features	Thresholding, Histogram equalization	N.H.Abd Halim M.Y.Mashor A.S.Abdul Nasir N.R.Mokhtar H.Rosline	2011
23.	Pre-Processing, Segmentation, Feature Extraction, Marker Cluster	Color Correlation, K-MEANS clustering, SVM classification, CD(cluster of differentiation) Marker, Performance Evaluation	Jakkrich Laosai Kosin Chamnongthai	2016
24.	Segmentation (HSV Color Model), Fluorescence in situ hybridization (FISH), Morphological analysis, Feature Extraction, Box Counting Method, Contour Signature,	Fuzzy Segmentation, SVM classifier, Hausdroff Dimension, Euclidean distance, Performance Evaluation	Subrajeet Mohapatra Sushanta Shekhar Samanta, Dipti Patra Sanghamitra Satpathi	2011
25.	Image Acquisition, Image Enhancement, Image Segmentation, Feature Extraction, Image Classification, Morphological Analysis, Wavelet Transforms	Zack Algorithm, Otsu's Threshold, Watershed Segmentation Algorithm, KNN(K-Nearest Neighbors) Classifier, Kernel Fuzzy Clustering Method (KFCM), K-Means Clustering, ANN	M.Saritha Prakash.B.B Sukesh.K Shrinivas.B	2016
26.	Image Acquisition, Pre –	EM Algorithm, Reinforcement	Fauziah Kasmin	2012

	Processing, Segmentation, Feature Extraction, Classification	Learning Algorithm, Fuzzy Based Segmentation, KNN classifier, SVM classifier, Gray Level Co-Occurrence Matrix (GLCM)	Anton Satria Prabuwono Azizi Abdullah	
27.	Enhancement, Clustering, Segmentation, Feature Extraction, Classification, Mathematical Morphology, Labeling	Morphological Edge Recognition Algorithm, K – Means Segmentation, Gray Level Co-Occurrence Matrix (GLCM), Gray Level Difference Method (GLDM), SVM Classifier, Histogram Equalization	Ashwini Rejintal Aswini N	2016
28.	Image Acquisition, Pre – Processing, Segmentation, Filtering Techniques, Geometrical Features, Classification	Zack Algorithm, K-Means Clustering, SVM Classifier, Histogram Equalization,	Nimesh Patel Ashutosh Mishra	2015
29.	Image Analysis, Pre – Processing, Segmentation, Classification, Laplacian Filter Mask, Mathematical Morphology	Sobel Edge Detector, K-Means Clustering, Edge Watershed transform, Patch Based FCM, Bayesian classier, Linear Discriminant Analysis(LDA), KNN, ANN, SVM Classifier	S.S.Savkare, S.P.Narote	2015
30.	Data Mining Techniques, Image Enhancement, Image Segmentation , Texture Features, Morphological Features, Classification, Pattern Recognition	WBC Counting Algorithm, Naive Bayes classifier, Directed Acyclic Graph, SVM Classifier,	Daniela Mayumi Ushizima, Ana C. Lorena Andr´e C. P. L. F. de Carvalho	2005

Rohan Kandwal et al. [5] proposed major image segmentation algorithms and also discussed factors which affected in image segmentation. Thus image segmentation there is no single algorithm that is applicable still remains a big pending problem in the areas of image processing.

Arti Taneja et al. [7] proposed an overview of various segmentation techniques. It states the efficiency of the segmentation process and improved with the help of several algorithms, namely active contour model, level set methods, Fuzzy clustering and K-means clustering. G. Nagaraju et al. [13] proposed an approach MRI image for the detection of brain tumor helps in finding the exact size and location of tumor. In morphological operators, the scanned image is enhanced to remove noise and then apply to detect the tumor cells. After that segmentation is carried out using K-means and fuzzy C-means clustering algorithm for better performance analysis. Sarthak Panda [14] proposed strategy to compare the performance of segmentation by K-means clustering and thresholding techniques for color images and to improve the image quality in aspects of precision and computational time by homogenous regions with respect to texture and color since no local constraints are applied to impose spatial continuity. Shailesh J. Mishra et al. [17] proposed to study of developing a detection of leukemia types using microscopic blood sample images and diagnosed at earlier stage. In this method blood cell image processing segmentation, deletion, fill hole and clear border operations are used to obtain the edge of the cancerous blood cell. Amruta Pandit et al. [19] proposed strategy to produce system that can detect and estimate the number of red sample image of blood cells using image processing algorithms. It states that automatic RBC detection and counting with different methodologies, in terms of efficient cost and time in order to get more accurate result. Deepika N. Patil et al. [20] proposed strategy for detecting the abnormalities of blood cells in less time in stipulated days. Image processing technique also helps in counting and segregating the blood cells in different categories based on the form factor with 83% accuracy is achieved and 29% of variation in observed values of abnormalities which are detected. Nimesh Patel et al. [28] proposed strategy for an automated system which can detect the leukemia from the microscopic image to improve the accuracy and reduce the time to detect than the manual approach. It states that the required parts of images are extracted, some filtering techniques are applied. K-means clustering approach is used for WBC detection. Histogram equalization and Zack algorithm is used for grouping WBC, followed by feature extraction are applied. Finally, SVM is used for classification, by using the image datasets which are collected can be carried out for testing and as of now, 93.57% accuracy is achieved. S.S.Savkare et al. [29] proposed strategy for vision-based cell segmentation system which is an efficient method for segmenting different blood component such as Red Blood Cells (RBCs), White Blood Cells (WBCs), Platelets from input images for blood count and also to detect the parasites present in blood cells using K-means clustering with global thresholding. To reduce the noise the method used is median filter and for enhancement laplacian filter are carried out. Overlapping cells are separated using Sobel edge detector for edge enhancement in grayscale images and Watershed transform for transformation interpretation of grayscale images.

Pawandeep et al. [4] proposed strategy used data mining techniques for genetic algorithms and neural networks are used for detecting the leukemia type of cancer. The leukaemia data set and the gene set is reduced by using the genetic algorithm. The matched and the unmatched values are classified by using the neural networks. SVM classifier may use for classification. Gurpreet Singh et al. [16] proposed strategy states when leukemia occurs when a big portion of non-standardized WBCs produced in the body by bone marrow. Segmentation process allows proper identification of numerous distinct cells that are affected to the patients. Several methods utilized such as Artificial Neural Network (ANN), Self-Organizing Map (SOM), and Linear Dependent Analysis (LDA) for classification for unsupervised learning technique. SVM another classification tool used for supervised learning system to examine data and also identify patterns. Jakkrich Laosai et al. [23] proposed strategy to classify leukemia using CD markers. Subtypes categories are classified such as Morphologic, Immunologic, Cytogenetic features immunologic markers (MIC), cluster of differentiation (CD). The features are extracted from the segmented images and classified using the SVM. In this method, 200 images set with 100 abnormal samples and 100 normal samples are utilized for evaluation and 93.89% accuracy is obtained. M.Saritha et al. B [25] proposed strategy to early identification of leukemia and types of blood cancer cells whether it is and classify image samples using various image processing techniques in order to have high reliability, efficacy, performance accuracy with robustness. Ashwini Rejintal et al. [27] proposed strategy for automatic image handling framework to determine cell segmentation followed by feature extraction to detect cancer cells. Segmentation helps in knowing the precise size and shape of the cancer cell and the area. Here, K-mean segmentation method is used for best segmentation performance.

Nameirakpam et al. [2] proposed strategy that image segmentation methods based on the clustering techniques can give efficient analysis of an image by using thresholding, edge detection, pixel clustering, growing regions to extract nucleus and cytoplasm of leukocytes.

III. CONCLUSION

The survey focuses to detect leukemia at earlier stage with the help of different algorithms. The result produced by hematologist will not be accurate when they done manually. The automated system helps to detect leukemia with greater accuracy. Support Vector Machine in classification and Otsu's thresholding algorithm in segmentation are most preferred by researchers to better segment images eliminating noise.

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