A Survey White Blood Cell Segmentation Techniques for Microscopic Images

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Abstract- *The WBC leukaemia has been observed in many patients. The Exudate leukaemia Disease is mainly divided into four types. Doctors need to capture approximately 20 to 50 pictures of WBC from different angle to identify the disease and its location. A technique used for segmentation FCM (Fuzzy C-Mean), FLICM was applied to segment the leukaemia images. But, the result was not so efficient in providing the spatial detail information of the actual disease part. So we apply KWFLICM (kernel weighted fuzzy local information C means) algorithm to detect and segment Leukemia. After that it extract the features from segmented image like centroid, perimeter, major axis, minor axis etc. and according to extracted features they classifies the types of leukemia for that purpose we use machine learning algorithm SVM(Support Vector Machine). Experimental result indicates that the SVM model illustrates the highest accuracy of classifications for leukemia cancer. By applying KWFLICM for segmentation and SVM to classification generates adaptive algorithm to detect and classify leukemia either it is CLL (Chronic lymphocytic leukaemia), CML (Chronic myeloid leukaemia), ALL (Acute lymphocytic leukaemia), or AML (Acute myeloid leukaemia).*

Keywords- Domestic Refrigeration, Refrigerant of R22and R134a, Blends of Refrigerant

I. INTRODUCTION

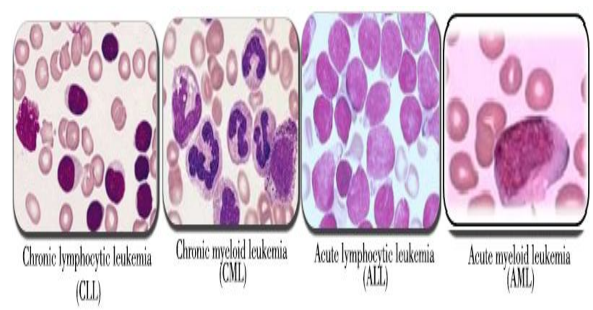
Leukemia is cancer of white blood cells that starts in the bone marrow, the soft material in the centre of bones that makes white blood cells, red blood cells and platelets.

The abnormal white blood cells in leukemia are genetically identical. They proliferate and eventually outnumber normal blood cells, interrupting their work.

"In the blood can be such a high count of white blood cells present that it can start causing problems in the circulation. In the bone marrow, the leukemic cells overtake the bone marrow and suppress the formation of the normal blood components," said Dr. Sarah Vaiselbuh, a paediatric haematologist and oncologist at Staten Island University Hospital in New York.

As a result, "at the time of diagnosis these children or adults are often anemic and need transfusion," Vaiselbuh said. "They have very low platelet counts and are at risk of bleeding, and most importantly, their normal blood cells are no longer produced in adequate numbers, so they can't fight infection."

There are four categories of leukemia based on how quickly the disease progresses (acute or chronic), and the kind of white blood cell that is affected (myeloid cells or lymphoid cells):



II. RELATED WORK

In paper [1] Viswanathan they introduces the new approach for leukemia detection which consist of (1) contrast enhancement to highlights the nuclei, (2) morphological contour segmentation, and (3) Fuzzy C means detection of leukemia. The contract enhancement is done by simple addition and subtraction operation to separate the nuclei. The morphological contour segmentation detects the edges of nuclei and eliminate the normal white blood cells from the microscopic blood image. Then the texture, geometry, color and statistical features of nuclei is evaluated to determines the various factors of leukemia. Finally it is trained by Fuzzy C mean clustering of single row feature vector of each cell is used to classify leukemia from white blood cells. The nuclei and leukemia segmentation based on morphological contour processing is enhanced and provided accurate segmentation of WBCs from the blood microscopic images. It is added with Fuzzy C mean classification trained with the extracted features row vector like perimeter, density and percentage from segmented nuclei with WBC provided accurate evaluation of leukemia. It ensures that proposed system provided accurate segmentation of leukemia from blood sub images. Thus the proposed approach provided viability of larger scale automated solution for detection and classification of normal and abnormal WBCs with less computation time and error rate.

In paper [2] S.S.Savkare, S.P.Narote approaches methods to segment the blood cells from microscopic thin blood images. This data is the premise to perform higher level tasks for example, automatic differential blood counting, detection of different diseases such as Malaria, Babesia, Chagas disease, Anemia, Leukemia etc. computer vision-based cell segmentation system 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 as well as to detect the parasites present in blood cells. Input images are captured by connecting digital camera to microscope. Captured images are enhanced and segmented using K-mean clustering as well as global threshold. Overlapping cells are separated using Sobel edge detector and Watershed transform.

In paper [3] Chaitali Raje, Jyoti Rangole proposed system will be on microscopic images to detect Leukemia. The early and fast identification of Leukemia greatly aids in providing the appropriate treatment. Initial segmentation is done using Statistical parameters such as mean, standard deviation which segregates white blood cells from other blood components i.e. erythrocytes and platelets. Geometrical features such as area, perimeter of the white blood cell nucleusis investigated for diagnostic prediction of Leukemia. The proposed method is successfully applied to a large number of images, showing promising results for varying image quality.Different image processing algorithms such as Image Enhancement, Thresholding, Mathematical morphology and Labelling are implemented using LabVIEW and MATLAB. The main aim of this paper is nucleus segmentation followed by feature extraction to detect Leukemia. Shape features of nuclei such as area, perimeter, etc. are considered for better accuracy of detection. The results show that the proposed statistical parameter such as mean and standard deviation based image segmentation and Otsu's thresholding based produced good segmentation performance. In addition, the fully segmented nucleus can be better achieved by using LabVIEW based algorithm because it is less sensitive to input image variations.

In paper [4] Shubhangi Khobragade1, Dheeraj D Mor2,Dr. C.Y.Patil they proposed a method of detection of leukemia in patients from microscopic white blood cell images. We have focused on the changes in the geometry of cells and statistical parameters like mean and standard deviation which separates white blood cells from other blood components using processing tools like MATLAB and LabVIEW. Images processing steps like image enhancement, image segmentation and feature extraction are applied on microscopic images. Image processing technique for leukemia diagnosis is time saving and cheaper as compare to the old laboratory testing method. Future scope will be to develop automatic classification system of white blood cells images using neural network. This will help in automatic detection of leukemia types in patients.

In paper [5] Anjali Gautam, H.S. Bhadauria they firstly apply color based segmentation on images for segmentation of white blood cell and platelets which is most important for localization of nucleus, then converting the segmented image to gray scale. We then analyze the nucleus features of white blood cells by mathematical morphing for removing the platelets from the segmented image and this result in final extraction of white blood nucleus. In this research results obtained give a good accuracy rate as compared to others**.** In research we firstly apply the color segmentation on image which separates the blue nuclei and the platelets from the other blood components. Then on this segmented image automatic thresholding and mathematical morphing is applied which result in the efficient segmentation of nuclei as compared to the other methods. This research introduces a method for white blood cells nucleus identification and segmentation as a first step towards a fully automatic system for diagnosis of different kind of diseases and classification using peripheral blood microscope image. White blood cell segmentation is the key procedure in the automatic leukemia diagnosis system.

In paper [6] Pronab Kumar Mondal1, Uzzal Kumar Prodhan2, Md. Selim Al Mamun3, Md. Abdur Rahim4, Kazi Kamal Hossain they have identified white blood cells from color images of blood smears. We have used Fuzzy C Means segmentation method and erosion and dilation post processing method to identify the white blood cells. In our obtained result we find that this method successfully identified 98% of white blood cells from which is a satisfactory result.identified white blood cells from blood smears. We have used Fuzzy C Means segmentation method and erosion and dilation post processing method to identify the white blood cells. Our method is more reliable and computationally less expensive .In our obtained result we find that this method successfully identified 98% of white blood cells from which is a satisfactory result.

In paper [7] Stelios Krinidis and Vassilios Chatzis This paper presents a variation of fuzzy c-means (FCM) algorithm that provides image clustering. The proposed algorithm incorporates the local spatial information and gray level information in a novel fuzzy way. The new algorithm is called fuzzy local information C-Means (FLICM). FLICM can overcome the disadvantages of the known fuzzy c-means algorithms and at the same time enhances the clustering performance. The major characteristic of FLICM is the use of a fuzzy local (both spatial and gray level) similarity measure, aiming to guarantee noise insensitiveness and image detail preservation**.** The FLICM introduces a new factor as a local (spatial and gray) similarity measure which aims to guarantee robustness both to noise and outliers. Also, the algorithmis relatively independent of the type of the added noise, and as a consequence, in the absence of prior knowledge of the noise, FLICM is the best choice for clustering. This is also enforced by the way that spatial and gray level image information are combined in the algorithm; the factor combines in a fuzzy manner the spatial and gray level information, rendering the algorithm more robust to all kind of noises, as well as to outliers. Furthermore, all the other fuzzy c-means algorithms for image clustering exploit, in their objective functions, a crucial parameter (or), which is used to balance the robustness and effectiveness of ignoring the added noise. This parameter is mainly determined empirically or using the trial-and-error method. The FLICM is completely free of any parameter determination, while the balance between the noise and image details is automatically achieved by the fuzzy local constraints, enhancing concurrently the clustering performance. This is alsoenhanced, by the fact, that almost all the other methods perform the clustering on a precomputed image, while FLICM is applied on the original image.

In paper [8] Huey Nee Lim#1, Mohd Yusoff Mashor#2, Nadiatun Zawiyah Supardi#3, Rosline Hassan This paper proposes a combination of color and morphological based segmentation techniques for blood cells segmentation on microscopic images. *K*-means clustering is implemented for color based clustering and primary segmentation of the image. The clustering is cascaded into two layers for cell recognition and background elimination. Morphological based segmentation is conducted using watershed transform based on gradient magnitude and skeleton by influence zone. The proposed method overcomes the problem of previous work which is over segmentation and efficiently segments the WBC cells and keep cytoplasm intact.The watershed algorithm has its advantages of reducing over segmentation, preserving edges shape, size and sub features of the objects. The experimental results proven that the incorporation of *k*-means clustering to obtain a primary segmentation of the blood cell images before applying the watershed segmentation to them is effective. The proposedmethod has achieved the objective of effectively segmenting the WBC cells and reducing the problem of over segmentation.

In paper [9] R. Shalini1 V. Muralidharan2 and M. Varatharaj proposes a novel approach to detect and segment the brain tumor tissues in MRI images. In this approach a method trade-off weighted fuzzy factor is used to segment the tumor region from the MRI images and kernel metric is used to increase the performance of segmentation results. Finally experimental results of the proposed framework gives better efficiency and provides higher accuracy than other compared existing approaches.This paper uses the method of kernel metrics and weighted trade-off fuzzy factor for brain tumor segmentation. This proposed method uses the combination of both kernel metrics and weighted trade off fuzzy factor mechanism and provides better segmentation accuracy. In table 1 and 2 given some parameter values, in that less elapsed time is given by FLICM, because it is simple algorithm of Fuzzy C Means. But comparing the other three techniques WFLICM, KFLICM and proposed KWFLICM, which is the combination of weighted trade-off fuzzy factor and kernel. From the comparison it is evident that the proposed approach KWFLICM gives less elapsed time also, proposed approach gives better segmentation accuracy than other approaches .In future this paper can extended to find out the types of disease in brain from CT-scan.

In paper [10] Jaroonrut Prinyakupt† and Charnchai Pluempitiwiriyawej The proposed WBC segmentation method that has been applied to two datasets, and the results are compared to the gold standard segmented manually by a haematologist. Both provide over 90% accuracy. This method is fast, robust and efficient. Consequently, white blood cell morphological characteristics can be extracted and used in linear and naïve Bayes classifiers for performance comparison. The linear classifier shows slightly better performance than the naïve Bayes one. In addition, the five types of white blood cells can be classified with high sensitivity.

In paper [11] Malek Adjouadi, Melvin Ayala, Mercedes Cabrerizo, Nuannuan Zong, Gabriel Lizarraga, And Mark Rossman addressed a critical classification problem that accurately delineated clusters of normal blood samples from clusters of blood samples with acute leukemia. The main objective was to provide a classifier for leukemia blood samples that performs well on a reduced amount of flow-cytometry parameters. As a result, an integrated software platform was developed that would serve as a reference tool for diagnostic references in flow cytometry.As far as competing methods, most consist of rule-based, expert system and type classifiers including cell images, simple peripheral blood samples, and gene expression, and not ANN as was implemented in this study.Furthermore the proposed classifiers can also be used as supporting tools in the diagnosis of these diseases. In pattern classification, it is perfectly valid to present patterns to different binary classifiers, such as the one-vs.-all algorithmespecially when the subject can have different disease states.

In paper [12] Sung-Huai Hsieh1, Zhenyu Wang2, Po-Hsun Cheng3, I-Shun Lee7, Sheau-Ling Hsieh7, Feipei Lai In the paper, we classify cancer with the Leukemia cancer of medical diagnostic data. Information gain has been adapted for feature selections. A Leukemia cnacer model that utilizes Information Gain based on Support Vector Machines (IG-SVM) techniques and enhancements to evaluate, interpret the cacer classification. The experimental results indicate that the SVM model illustrates the highest accuracy of classifications for Leukemia cancer.

III. DIFFERENT METHODS FOR SEGMENTATION

A. Fuzzy C-Means (FCM) Algorithm

1. Set values for ,m , and €
2. Initialize the fuzzy partition matrix $U^{(0)}$

$$v_j^{(b)} = \frac{\sum_{i=1}^{N} \left(u_{ji}^{(b)}\right)^m x_i}{\sum_{i=1}^{N} \left(u_{ji}^{(b)}\right)^m}.$$

3. Set the loop counter b = 0
4. Calculate the cluster centres $v_j^{(b)}$ with $U^{(b)}$
5. Calculate the membership matrix $U^{(b+1)}$.

$$u_{ji}^{(b+1)} = \frac{1}{\sum_{k=1}^{c} \left(\frac{d_{ji}}{d_{ki}}\right)^{2/m-1}}.$$

6. If max $\{U^{(b)} - U^{(b+1)}\} <$ € then stop, otherwise set b = b+1 and go to step 4.

B. Fuzzy local information C-Means (FLICM) algorithm

1. Set the number of the cluster prototypes, fuzzification parameter and the stopping condition €.
2. Initialize randomly the fuzzy partition matrix.
3. Set the loop counter b = 0.
4. Calculate the cluster prototypes using equation.
5. Compute membership values using equation.
6. Max {U(b) – U(b+1)} < € then stop, otherwise set b = b + 1 and go to step 4.

C. Kernel weighted Fuzzy local information C-Means (KWFLICM) algorithm

1. Set the value of C, M, ε and window size.
2. Initialize the Fuzzy cluster prototype
3. Set loop b =0
4. Calculate Trade-off weighted fuzzy factor w_{ij}& update the partitioning method
5. Update the cluster prototype
6. If max$|V_{new} - V_{old}| < \varepsilon$. Then Stop, otherwise B=B+1 and go to step 3.

Table 1: Comparative Analysis

Methods	advantages	limitations
1. FCM[1]	-Accurate -Works well for noise free images.	-Apriori specification of no. of clusters. -increase no. of iteration. -sensitive to noise.
2. FLICM[7]	-enhance clustering performance. -image detail preservation. -effective and efficient.	- Works on fixed distance. - Objective function is defined previously.
3. KWFLICM[9]	-Better segmentation -Better accuracy -less elapsed time.	- At each iteration it's necessary to calculate or update trade of fuzzy factor. - Works on adaptive distance.

IV. CONCLUSION

From my literature survey, there are different methods for segmentation of leukaemia, among them KWFLICM gives better result in future scope.it also takes less elapsed time. Proposed approach gives better segmentation accuracy than other approaches which is the combination of weighted trade-off fuzzy factor and kernel.

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