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Automated Detection of Leukaemia Based on Microscopic Images- A Review

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Abstract:-Leukaemia is a chronic disease in human characterized by an abnormal increase in the number of white blood cells (WBC). The existence of abnormal blood can be detected when the blood sample is taken and examined by hematologist, the process require human expertize and is time consuming. Hence,a fully automated algorithm by use of image processing to aid in the detection of leukaemia by identifying and counting the infected WBC. As per the literature review, WBC detection includes segmentation, feature extraction and classification. Recent techniques used for segmentations are Watershed and Ostu which provides an accuracy of about 90-95%,the feature extraction methods involving Hausdroff dimension and Packing dimension bring only 70% accuracy. The classification performed using classifier like k-nearest neighbor, feed forward neural network provides 92% accuracy.

Keywords:-Luekaemia, Whitebloodcells, Manual Examination, İmageprocessing, Microscopic İmages, Automateddetection

I. INTRODUCTION

Leukaemia is the cancer of blood and bone marrow. The bone marrow produces a large number of abnormal white blood cells (WBC). Abnormal cells will not function properly as same as normal cells. Leukaemia can be a malignant disease if not properly treated. It is broadly classified as: 1) acute leukaemia (which progresses quickly) and 2) chronic leukemia (which progresses slowly). The word "acute"(acute myelogenous leukemia) means the rapid increase of the abnormal WBC cells. Acute Myelogenous Leukemia (AML), affects a group of WBCs called the myeloid cells, which develops into different types of mature blood cells like white blood cells, red blood cells, and platelets. Due to the irregularity in the production of blood cells, it could turn out to be AML. In the case of chronic leukaemia, the abnormal increase of blood cells and symptoms will take so many years. Leukaemia can be cured if it is detected in early stages and treated.

Automated Leukaemia detection originates from the available methods which involves manual examination of the blood smear as an initial diagnostic step for proper diagnosis. The manual process consumes more time and also its accuracy is mainly depend on examiners ability. Further, the detection task is usually difficult due to the variety of parameters and unclear smear images will miss out the important clues for the detection of leukaemia. Due to the complex nature of blood smear images and variation in slide preparation, much work has to be done to meet the clinical use. So these factors can point to wrong diagnosis.

The digital image processing techniques were used to identify and analyze the infected cells that lead to more accurate, standard, and remote disease diagnosis systems. There are some complications in extracting the data from WBCs due to great variation of cells in shape, size, edge, and position. Likewise, the image contrast between background and blood cell boundaries can also be affected in the changes in the capturing process, illumination imbalance will occur.

Image segmentation is a method which can be used to understand images and extract information or objects. It is the primary used for automated detection. Feature extraction in image processing is a technique of redefining a large set of redundant data into a set of features (or feature vector) of reduced dimension. This transformation of the input data into the set of features is called feature extraction.The complete classification system is to detect leukaemia from blood images is based only on morphological features and using only gray level images.A common recede s that only sub images can be classified easily.

II. LITERATURE REVIEW

Several efforts made in earlier times to construct systems that could be of help in segmentation and classification of acute leukaemiais discussed [1]. The following are the four kinds of segmentation techniques: a) thresholding techniques, b) boundary-based, c) region-based segmentation and d) hybrid techniques that unifies the boundary and region criteria. The region-based or edge-based schemes are the most popular

segmentation techniques for the peripheral blood or bone marrow smear. An appropriate blend of both boundary and region information would show better results than the other method. The color images will be more reliable image segmentation than that of gray-scale images. In this paper, numerous segmentation algorithms were used such as Otsu segmentation. Automated histogram thresholding were used to segment WBCs from the blood smear images. This paper aims to identify the irregularities in the nucleus boundary. Selective filtering will also be used to segment leukocytes from the other blood components. The major factors have to be considered to identify the cytoplasm and nucleus of WBCs hue, saturation, and value,color space, and expectation–maximization algorithm (which comprises of two steps, expectation and maximization steps). A watershed segmentation algorithmwill be more suitable for to segment nucleus from the surrounding cytoplasm of cervical cancer images. An unsupervised color segmentation to show up the WBCs from acute leukemia images. In this paper, they attentive to implement a fully automated classifier system for AML (Acute Myelegenous Leukemia). A fully constructed system is functional to complete blood smear images containing multiple nuclei. Two new features such as cell energy and Hausdorff dimension (HD) from the existing methods are used to optimize better results.

The research on image segmentation has been strengthened after so many years. Though there are continuous research on different segmentation algorithms, till now a single algorithm for different images cannot be proposed. Therefore, an algorithm is developed for one set of images which cannot be applicable to a different set of images is discussed byAthira Krishnan, Sreekumar K[2].Whether a single and banded avenue for image segmentation can be developed, which could be used for all quality of images or not remained as the main challenge. After so many years of research, various automatic segmentation and leukemia detection methods for blood smear images have been proposed. Among this, Otsu segmentation and automated histogram thresholding were in place to segment WBCs from the blood smear image. The paper reviews the contour signature to identify the irregularities in the nucleus boundary of WBC cells. Then it will use the selective filtering to segment leukocytes from the other blood cells. This paper conferred in unsupervised color segmentation to bring out the WBC from acute leukemia images. A two-step segmentation process using HSV color model is used in this paper.

Ruggero Donida Labati, Vincenzo Piuri, Fabio Scotti too had proposed various methods explaining how to segment, refine the segmentation (to correctly segment clusters of cells) or detect incorrect segmentations of white blood cells. This paper discloses the methods of enhancing the microscopic images by removing the undesired image background components. It also suggests a method for the robust estimation of the mean cell diameter and a fully self adaptive segmentation strategy to sturdy identify white blood cells. Some works related to the Acute LymphocyticLeukaemia(ALL) recognition depends on different ways such as the analysis of gene expression, hem cytometer statistics and holographic microscope images. For the proper classification of ALL disease, there is no possibility to test the public supervised image datasets and quiet to compare the algorithms for cell segmentation.

This paper deals with a microscopic digital image of bone marrow smear used as the input to the leukaemia detection [4]. A blood image contains different types of cells but we are mainly focused only on white blood cells. Image segmentation is a method used to segment the WBCs. This plays an important role in separating the unwanted RBCs, blood platelets and other WBCs which are not under current examination. The colored image obtained is converted to the gray scale image because processing of gray scale image is easier than colored image. To get the exact boundary of nucleus, the geometrical properties are required. The sobel edge enhancing method is used for the further proper extraction of the nucleus. The nucleus is normally surrounded by the cytoplasm which overlaps the boundary of the nucleus, the opening morphological operation is used which includes erosion followed by dilation for removing overlapped region. The next step is removal of excess background portion to obtain the image such that its boundaries are tangential to the edges of the nucleus, which is done by cropping operation. This method is more subjected to the geometrical properties of the nucleus such as Area, Centroid, Major Axis Length, Minor Axis Length, Eccentricity, Convex Area, Solidity, Perimeter Circularity, and Rectangularity. These properties give the feature vector which is used to construct the training sets of abnormal and healthy cells. The training set is then used in classification of the input bone marrow smear using a Euclidian Distance Algorithm.Discrete Cosine Transform is technique is based on image transforms. It focuses purely on the geometric properties of the nucleus. From the analysis, it can be inferred that not only the geometric properties are essential but the texture and the consistency of the image is also very important. The transform based technique represents the changes in the frequencies in the image and its energy. The process from obtaining the input image up to the cropped nucleus is identical to that of first method, then the image is scaled to the required resolution. Discrete Cosine Transform has been applied and the transformed image is stored as a feature vector, thereby constructing the training set. This training set is used for classification of cancerous cells.

Our focus is on the automated differential blood counting system support for the diagnosis of leukaemia in [5]. Most of the segmentation techniques will extract the nuclei and other methods helps extract the cytoplasm with less exactness. One of the main problem for higher cytoplasm error is thru use of gray level intensity or color (Red–Green–Blue) intensities as features which are linearly inseparable in the image plane. From, so many simulation results, the performance of various

pre–existing methods fail to classify boundary pixels (nucleus–cytoplasm and cytoplasm–background) in WBC images due to overlappingof color. Diagnostic misunderstanding occurs due to imitation of similar marks by other disorders. Additionally, the identification is usually difficult task due to the variability of features and frequently unclear images cause missing out on vital features as to confirm the presence of leukaemia. It is predicted that the total number of deaths during a year due to leukaemia and lymphoma will be 23,720 and 20,200 respectively. So this automated blood count system is very suitable for extracting the nuclei and cytoplasm of WBC.

In this article, they explains about the two steps of segmentation process using HSV color model is used [6]. Color segmentation procedure is applied WBC microscopic images using mean-shift. It introduces the use of shape analysis instead of other features for the segmentation of WBC. Similar researches on blood cell segmentation and detection also done to achieve better diagnosis. Owing to complex nature of the blood smear images and disparity in slide preparation techniques, much effort has to be done to achieve the exact clinical demands. So, the automation process merely depends upon apt segmentation and feature extraction techniques. This paper suggests a method to automate peripheral blood film examination which can complement the hematologist with objective data for better diagnosis and treatment. The technique we introduces is for separating the leukocytes from the other blood cells, it extracts the lymphocytes from the subclass. Fractal features, shape features are mainly extracted from lymphocytes in the image. In addition to this, two new features for cell nucleus, boundary roughness measurement is proposed for proper detection of leukaemia. Support Vector Machine (SVM) is used for classifying the nucleus images based on the extracted features of healthy person and leukemic.

The observation of the peripheral blood film by expert operators is one of the diagnostic procedures available to evaluate the presence of the acute leukaemia or not. This type of examination suffers from slowness and it doesn't show a standardized accuracy because it mainly depend on the examiner's expertise and skill. For the morphological analysis requires an image, not a blood sample. Therefore, this type of examination is suitable for low-cost, standardized, accurate, and remote diagnostic systems. This paper aims to demonstrate that the peripheral blood film observation can be fully automated and can be performed as ancillary service to the physician activity. In this context, tens of thousands cells belonging to a blood slide can be analyzed looking for one blast cell. Merely rare attempts of partial or full automated systems based on image processing were discussed in [7].

Anu Jacob, Flower Abraham Mundackal explains that acute leukemia is often challenging diagnosissince the exact cause is unknown. In addition, the symptoms of the disease are very similar to common diseases like flu, fever, weakness, tiredness, or aches in bones or joints. Since there is no staging for AML, the choice of treatment can be varied according to the condition of patients. Likewise, it is difficult to obtain a consistent result from visual inspection.

Visual inspection also can give qualitative results for further research. In order to know all information about blood, costly testing and equipment of labs are required. Automatic image processing system is immediately needed and can overcome related controls in visual inspection.

The goal of this literature review is to implement a fully automated classifier system for Acute Leukemia. Most of the existing systems, work on sub-images where only one nucleus per image is considered and hence the features are being extracted only for those sub-images instead of whole images. So, our intention is to overcome the drawbacks and also increase the overall accuracy of the classifier system. This system challenges to acts as an efficient ancillary to the physicians in decision-making.

III. METHODS FOR DETECTION

Leukaemia detection is basically done by two methods: 1) Manual examination 2) Automated examination. Most of the laboratories use manual examination for diagnosis of Leukemia. Manual examination needs an expertized hematologist for confirmation of leukemia and it is very time consuming process. The accuracy of the manual examination depends on the operator's ability and fatigue level. Due to this a standardized accuracy cannot be achieved. The main drawback of manual examination is that the transfer of liquid blood samples is a difficult task than microscopic images.

Automated examination is mainly focused on the WBC detection for the diagnosis of luekaemia. WBC detection includes segmentation, feature extraction, and classification. Recent techniques used for segmentations are Watershed and Ostu segmentations which provides an accuracy of about 90-95%, the feature extraction method involves Hausdroff dimension and Packing dimension bring only 70% accuracy. The classification performed using classifiers like k-nearest neighbor, feed forward neural network provides 92% accuracy. The major drawback of automated examination is that overlapped group of cells in the microscopic images cannot be segmented properly in the automated examination and this will leads to missegmentation.

IV. CONCLUSION

This paper aims at elucidating the relevance and significance of automated digital imaging of detection of leukaemia more accurate and faster. Thepaper comprises various methodsused in detection of luekaemia based on microscopic images.In short it examines the vulnerability of manual examination, for

the proper diagnosis due to the lack of human expertize. An automated examination for leukaemia helps the medicos to overcome several lacunae and complications and also to helpeasily differentiating the normal WBC and leukemia affected WBC. For the timely and accurate detection of leukaemia, the geometrical properties, shape, and texture of blood cells are used as main features.Inadequacy in exactly identifying any of these features will result in wrong diagnosis.Therefore, there is a greater need and relevance for mending the accuracy of segmentation, feature extraction and classification methods for the efficient diagnosis. Hence, an automated leukemia detection algorithm based on microscopic images is used for achieving better accuracy.

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