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AUTOMATED DETECTION AND CLASSIFICATION OF LEUKEMIA USING IMAGE PROCESSING AND MACHINE LEARNING

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ABSTRACT

Leukaemia stands for blood cancer that begins in the bone marrow and results in the generation of abnormal cells. Leukaemia is mainly classified as acute lymphoblastic leukaemia (ALL), acute myeloid leukaemia (AML), chronic lymphocytic leukaemia (CLL) and chronic myeloid leukaemia (CML).This thesis makes an effort to devise a methodology for the detection and classification of Leukaemia. The images have been segmented using HSV colour based segmentation algorithm. The morphological components of normal and Leukemic lymphocytes differ significantly; hence various features are extracted from the segmented lymphocyte images, for detection purpose. The leukaemia is classified using SVM classifier.

Keywords: HSV colour based segmentation algorithm,SVM Classifier.

I. INTRODUCTION

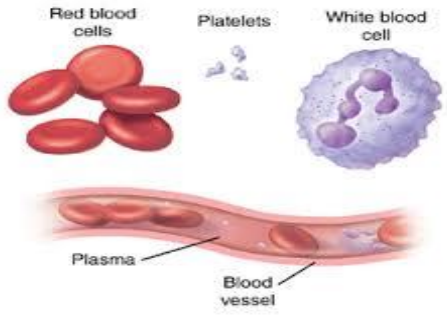

Figure.1- Components of blood

Many Image processing algorithms have been developed for Leukaemia detection. Image segmentation is a fundamental problem in automated haematological analysis and needs to be accurately carried out. In automated image segmentation the thresholding is done by Otsus method because in Otsus method the threshold value is automatically selected [14]. The watershed transform breaks the connected objects at their weakest point, and separates overlapped objects [29].Himali Vaghela carried out the segmentation of the white blood cells by using Watershed transform to separate the overlapping WBC, but noticed that the exact separation of cells was not possible [1]. Aimi Salihah proposed the use of three contrast enhancement techniques for colour images using RGB components [12]. The Colour images allow for more reliable image segmentation than greyscale images. Two of the basic models for colour images are the HSI (Hue, Intensity, and saturation) Colour space and the

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RGB (Red, Green, and Blue) colour space [14]. The three Components of RGB colour model is highly correlated, so the chromatic information is not suitable for direct processing. Due to colour space, it is convenient to convert from RGB to HSV (Hue, Saturation and Value) colour space [11]. RGB images is difficult for segmentation, hence is converted into the HSV colour space to make segmentation easy[14].This reduces correlation between the colour channels (compared to RGB) and enables dealing with three H, S and V channels separately [24]. The feature extraction technique which is carried out after the segmentation process plays a vital role in differentiating the normal cells from the leukemic ones. The features are extracted from the nucleus of the wbc[29].Subrajeet Mohapatra suggested that features such as fractal dimension, shape features including contour signature and texture could be extracted for detection of leukaemia [2, 7]. Once leukaemia is detected, it needs to be classified into its types (Acute or Chronic). Subrajeet Mohapatra suggested the use of SVM classifier and FLANN-Functional Link Artificial Neural Network for classification purpose [2, 7].The Support Vector Machine (SVM) classifier has been most commonly used for classification [27]. If the patterns are very close in the feature space, support vector machine (SVM) is a suitable choice for classification. It is a powerful tool for data classification based on hyper plane [24].N. Z. Supardi proposed to use k-nearest neighbour to classify blasts in acute leukaemia into two types which are AML and ALL [9].

II. PROCESS OVERVIEW

Figure 2 gives a detailed description of the sequence of steps that have been followed for efficient detection and classification of leukaemia.

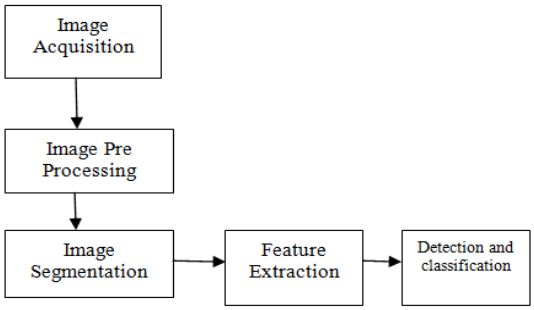

Figure. 2-Process flow

Image Acquisition-

Images of the blood smears of leukemic patients and images of the blood smears of non leukemic patients; have been obtained from online databases.

Image Pre-processing-

Image pre-processing is a technique by means of which the signal to noise ratio and image quality can be improved, that will be helpful for further processing processes. The images that were obtained were in CMYK form, hence were pre processed and converted to RGB form.

Image segmentation algorithm-

The main aim of the segmentation process is to simplify and represent the image into something more meaningful and easier to analyze. The HSV colour based segmentation algorithm has been used in this case. HSV stands for Hue, Saturation, and Value. This colour model is based on polar coordinates. H component in

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HSV colour space contains most of the WBC information while the S component contains the structure information of the WBC nucleus.

Feature extraction-

While analysing data, the major problem arises due to the number of variables involved that require a large amount of memory and computation. This problem is overcome by feature extraction. The features that were extracted are shape based features and statistical features.

Classification-

The classification model chosen for this phase is the Support Vector Machine, which is a machine learning technique. Since the patterns are very close in the feature space, support vector machine is a suitable choice for classification. It is a powerful tool for data classification based on hyper plane classifier.

III. EXPERIMENTAL RESULTS

The dataset under consideration consists of 400 images of blood smear. Figure 3 shows the segmentation output obtained after implementing the HSV colour based segmentation.

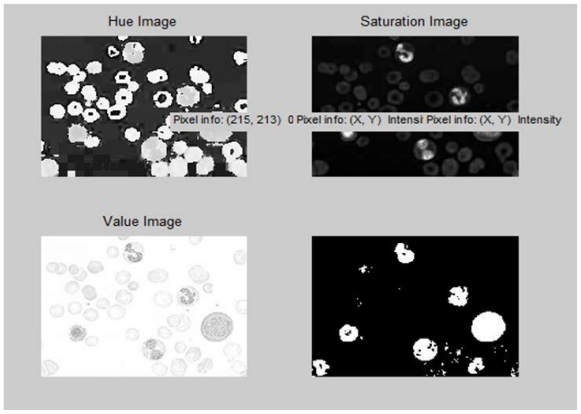

Figure 3 Segmentation of blood smear image using HSV colour based segmentation

The image segmentation and feature extraction is followed by the detection and classification process. The SVM classifier is used to detect whether the person has leukaemia or not. If the person is detected with leukaemia, then the type of leukaemia is detected i.e. whether it is ALL, AML, CML or CLL.

TABLE 1 Feature extraction of images segmented using HSV colour based segmentation Algorithm

Feature Extracted	Normal Blood smear	AML Blood smear	ALL Blood smear	CML Blood smear	CLL Blood smear
Size	235. 5257	218.0 911	198.8931	171.4466	220.1311
Mean	22. 8690	44.0984	50.3336	57.0832	43.5155
Entropy	-0.9175	-0.8451	-0.7653	-0.6720	-0.8536
Standard Deviation	-0.080	-0.0299	-0.0390	-0.0530	-0.0291
Smoothness	-6.1458	-3.0507	-1.1541	-0.1727	3.1923
Skewness	1.00	1.00	1.00	1.00	1.00
Contrast	0.0047	0.0317	0.0243	0.0611	0.0186
Kurtosis	0.0164	0.0650	0.0230	0.0274	0.0107
Homogeneity	0.2945	0.0119	0.4443	0.4798	0.4131
Correlation	0	0	0	0	0
Variance	15.9375	15.9375	15.9375	15.9375	15.9375

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IV. CONCLUSION AND FUTURE WORK

The paper mainly focuses on the detection of Leukaemia and provides a broader range of Leukaemia classification into its four main types. HSV colour based segmentation was used for image segmentation. A large number of features were extracted to make the detection process more accurate. This work can further be extended by detecting the subtypes of leukaemia types, e.g. AML M3 is a subtype of AML. More segmentation algorithms can be explored, so as to obtain better results as compared to the previous ones.

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