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DETECTION OF WHITE BLOOD CELL IMAGE USING NUCLEUS SEGMENTATION

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Abstract- *Leukemia is the most critical blood disease, common in children and adults. Images processing steps like image enhancement, edgedetection, image segmentation and feature extraction are applied on microscopic images. Detection through images is fast and feasible method as they avoid special need of equipment for lab testing. This project aims to provide user friendly software based on MATLAB allowing for quick user interaction with a simple tool for the detection and segmentation of white blood cells from images of blood samples. The Sober method with FCM (Fuzzy C-means clustering) is used for detection and feature extraction of blood cells.*

KEY WORDS: White Blood Cell Segmentation, Sobel Method with FCM, Detection of Leukimia Types.

1. INTRODUCTION

Blood disorder is considered among the most dangerous of diseases that can lead to death. Many of these blood diseases are defined to white blood cells such as Leukemia.Leukemia is an abnormal condition in the body because it produces excess white blood cells (leucocytes) in the bloodstream and spinal cord.Therefore, these abnormal conditions will disrupt the production of other blood cells and disrupt the flow of blood into the vital organs.The screening of prepared blood samples by pathologists for counting and classification of WBCs is tedious, slow, and time-consuming. Consequently, an automatic system based on image processing techniques is useful for aiding pathologists.Meanwhile, segmentation is one of the main steps in microscopic image analysis that the result of this step directly influences in the outcomes of the following steps such as feature extraction and classification.

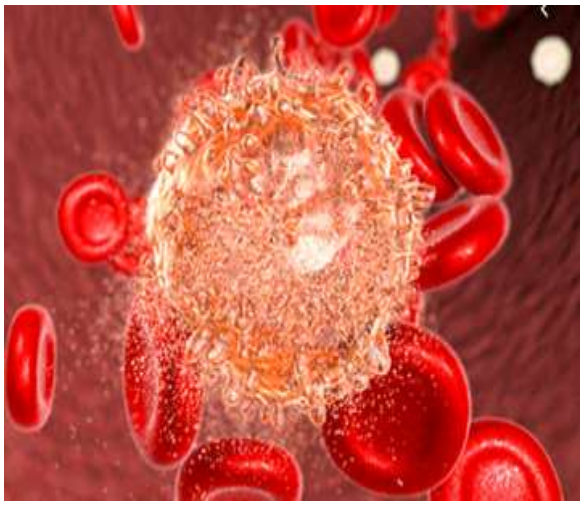

FIG.1 LEUKEMIA

Leukemia is the most critical blood disease, common in children and adults. A majority cancer cell begins in body parts but leukemia is the type of cancer which begins and grows in blood cells. Blood is crucial content without which metabolic functions of body severely affects .Human system is like, cell grows and multiply into new cells. Old cells are destroyed and so that new cells can take their place. In cancer, an old cell does not die and remains in the blood so that new cells which are produced cannot get enough space to live. In this way, functioning of blood disturbs and white blood cells production is abnormal and uncontrolled.

1.1 COMPONENTS OF HUMAN BLOOD CELL:

Blood cells are produced from the stem cells present in bone marrow. Blood consists of following components.

• Red Blood Cells (Erythrocytes): RBCs has a capacity to carry oxygen to and take back CO2 away from tissues.

• White Blood Cells (Leukocytes): WBCs are the cell which fights with the foreign bodies and prevents from infection. There are different types of WBCs like lymphocytes, monocytes, eosinophils, basophils and neutrophils.

According to WBCs types there are different types of leukemia.

• Blood Platelets: It helps for the clotting of blood and controls bleeding.

1.2 TYPES OF LEUKEMIA:

Person suffering from leukemia is characterized by abnormal and irregular shape of white blood cells. These abnormal cells affect normal cells and them difficult to work. Leukemia cells are referred as blast cells. According to rate of propagation of WBCs there are two main types like acute leukemia and chronic leukemia

Acute Leukemia: It is characterized by rapid progression of disease and production of immature WBCs. This becomes severe in less time so it's difficult to treat and cure. Most Common in small children. Two more common types as acute lymphocytic and acute myeloid leukemia.

1) Acute Lymphocytic Leukemia (ALL): It occurs in children of age 1-12 years and adults of age 40 years. Here lymphocytic cell of WBCs gets affected. ALL also known as acute lymphoblastic leukemia. ALL most common in men compare to women (4).

2) Acute Myeloid Leukemia (AML): It occurs in children of age 1 year and old age patient .Enlargement of spleen and bone pain these are the prime symptoms of acute myeloid leukemia. In this myeloid line of stem cells are affected.

Chronic Leukemia: Human body does not show any symptoms at early stages. Means at early stage abnormal cells does not affect the working of normal cells. It progresses slowly and affects large area of blood cells and getting symptoms at last stage. At last stage, it is incurable.

1) Chronic Lymphocytic Leukemia (CLL): It occurs in senior citizen patients who suffer from old age diseases. Lymphocytes are affected. It does not show any symptoms at early stage.

2) Chronic Myeloid Leukemia (CML): It occurs in middle age patients of age 35 45 years. Genetic changes occur at early stage of myeloid cells.

1.3 OBJECTIVE

- Goal of segmentation of blood cells is to isolate the region of interest from the complicated background and to segment every cell into its components such as nucleus, cytoplasm and other parts. A WBC count can detect hidden infections within your body and alert to undiagnosed medical conditions, such as blood disorders.
- The main objectives of our project is to detect the diseases such as type of leukemia.

2. RELATED WORK

The Image segmentation is the focus in the image processing technology all the time. Medical image segmentation is an important application in the field of image segmentation. Wavelet transform is proposed to segment medical image. Firstly the gray level histogram of the medical image was processed using multiscale wavelet transform. Then the gray threshold was gradually emerged by the performance from large scale factor to small scale factor. At last the difference of the effect between traditional method and wavelet transform method were compared. The experimental results showed that the last method surpasses the traditional one in image segmentation and the results has been demonstrated to have validity and practicability. Image segmentation can achieve the anatomical structures and other interesting information of a medical image automatically or semi-automatically, which is helpful on the medical diagnosis [1].This paper depicts the image processing algorithms that treat the problem of image segmentation. Both K-means cluster and neural network based on pixel RGB space colour are described like segmentation algorithms. A popular K-means clustering algorithm is used to obtain the homogenous regions of an image by grouping pixels in an image based on color and texture. A Biological Neural Network or simply BNN is an artificial abstract model of different parts of the brain or nervous system, featuring essential properties of these systems using biologically realistic models Artificial Neural Networks (ANNs) have been developed for a wide range of applications such as image enhancement, segmentation, feature extraction, and object recognition. Among these, image segmentation is more important as it is a critical step for high-level processing such as object recognition. With the K-means algorithm, one may get some faulty segmented pixels while the use of neural network techniques may increase the performance but some errors might remain [2].Medical Image Processing is the fast growing and challenging field now a days. Medical Image techniques are used for Medical diagnosis. Brain tumor is a serious life threatening disease. Detecting Brain tumor using Image Processing techniques involves four stages namely Image Pre-Processing, Image segmentation, Feature Extraction, and Classification. Image processing and neural network techniques are used to improve the performance of detecting and classifying brain tumor in MRI images. In this survey various Image processing techniques are reviewed particularly for Brain tumor detection in magnetic resonance imaging. More than twenty five research papers of image processing techniques are clearly reviewed [3]. In order to improve patient diagnosis various image processing

software are developed to extract useful information from medical images. Hematologist makes the microscopic study of human blood which led to a need of methods, including microscope colour imaging, segmentation, classification, and clustering that can allow the identification of patients suffering from leukemia. Leukemia is related with blast white blood cell (WBC). The nonspecific nature of the signs and symptoms of ALL often leads to wrong diagnosis so hematologist also find difficulty for blast cell classification hence manual classification of blood cells is time-consuming and susceptible to error. Therefore fast, accurate and automatic identification of different blood cells is required. This paper has proposed automatic Otsu's threshold blood cell segmentation method along with image enhancement and arithmetic for WBC segmentation. kNN classifier has been utilized to classify blast cells from normal lymphocyte cells [4].For the fast and cost effective production of patient diagnosis, various image processing techniques or software has been developed to get desired information from medical images. Acute Lymphoblastic Leukemia (ALL) is a type of leukemia which is more common in children. The term 'Acute'means that leukemia can progress quickly and if not treated may lead to fatal death within few months. Due to its non specific nature of the symptoms and signs of ALL leads wrong diagnosis. Even hematologist finds it difficult to classify the leukemia cells, there manual classification of blood cells is not only time consuming but also inaccurate. Therefore, early identification of leukemia yields in providing the appropriate treatment to the patient. As a solution to this problem the system propose individuates in the blood image the leucocytes from the blood cells, and then it selects the lymphocyte cells. It evaluates morphological index from those cells and finally it classifies the presence of leukemia.

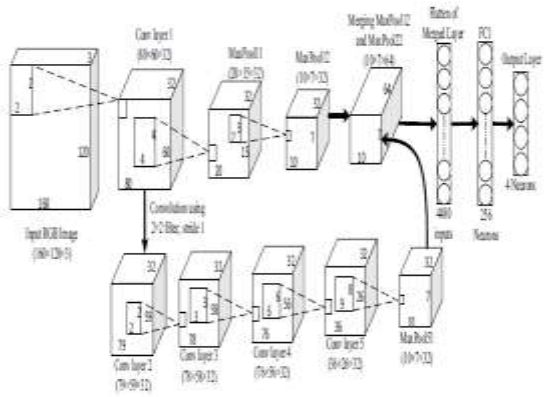

FIG.2 PROPOSED FUSION CNN MODEL

2.1 DISADVANTAGE:

- Setting of proper threshold value would be difficult.
- Time consuming.
- Inaccurate
- Low reliability.
- Chance for error occurrence.
- Speed of output extraction is slow.
- Over-segmentation and sensitivity.

3. PROPOSED SYSTEM

In Proposed work, Image Acquisition, Image Preprocessing, Image Segmentation, Feature Extraction, Detection of Cancer cells is used to detect leukemia. Image acquisition-Digital microscope which has inbuilt camera inside it, which trend to acquire digital images of cell. Image preprocessing avoids shadows of nuclei. Image segmentation of microscopic blood cell images are done to locate the WBCs structure which are abnormal. Feature extraction-Features of WBCs are extracted to decide whether the cell is blast or normal. The FCM (Fuzzy C-means clustering) is used for detection and feature extraction of blood cells.The principal aim of image segmentation is the extraction of significant objects presented in the image either by partitioning the image into connected semantic regions or by extraction one or many specific objects from the image and one of the main concern for the matter of segmentation nowadays is medical images. Segmentation based on clustering is a popular method for extracting regions of microscopic images.Segmentation is one of the fundamental tasks in the microscopic image analysis. The purpose of segmentation in the microscopic image is to separate image into four different regions, namely: background, RBCs, cytoplasm, and nucleus of WBCs.

Proposed method of detection of leukemia from microscopic blood cell images consists of stages like image acquisition, image preprocessing, image segmentation and feature extraction.

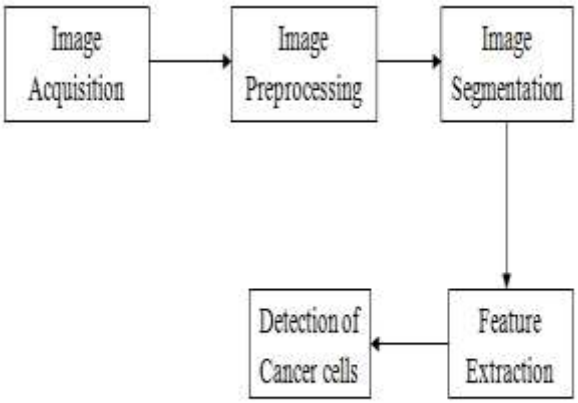

FIG.3 BLOCK DIAGRAM

3.1 MODULES

IMAGE ACQUISITION:

The first step in the process is image acquisition-that is, to acquire a digital image. To do so requires an imaging sensor and the capability to digitize the signal produced by the sensor. The nature of sensor and the image it produces are determined by the application. Microscopic images of blood cells are acquired with the help of digital microscope. Digital microscope which has inbuilt camera inside it is in trend to acquire digital images of cell.

IMAGE PREPROCESSING:

Pre-processing typically deals with techniques for enhancing contrast, removing noise and isolating regions, Grayscale image, binary image, hsv image whose texture indicates the likelihood of alpha-numeric information. Acquired images have all blood elements colors close to background color, red blood cells are clustered with white blood cells and the presence of noise and stain in the blood slides is significant. After contrast stretching image is converted in to Grayscale Image. Original blood cells images are in color. To ease the process of ratio determination, the original images will be converted into grayscale color. Grayscale represents the intensity of the image. In Matlab 16.0, this can be done by using RGB2GRAY function. The RGB2GRAY converts RGB image to grayscale by eliminating the hue and saturation information while retaining the luminance after the digital image has been obtained, the next step deals with pre-processing that image. The key function of preprocessing is to improve the image in ways that increase the chances of success of the other processes. Due to excessive stains and manual intervention microscopic images which are acquired possesses noise. Here noise present are mainly shadows of nuclei .Our region of interest is blood cell nucleus, so we process images to remove unwanted noises and recover important one. After pre-processing, image enhancement is done. Image enhancement operations improve the quality of an image. They can be used to improve image‘s contrast and brightness characteristics, reduce its noise content or sharpen its details.

IMAGE SEGMENTATION:

Segmentation of an image entails the division or separation of the image into regions of similar attribute. The most basic attribute for segmentation is image luminance amplitude for a monochrome image and color components for a color image. Segmentation involves separating an image into regions corresponding to objects; it involves selecting only the area of interest that is WBC in an image. This is done by removing all the unwanted area that is RBC, platelets and stains in an image and preserving only the required area. Thresholding creates binary images from graylevel ones by turning all pixels below some threshold to zero and all pixels about that threshold to one.Image edges and texture are also useful attributes for segmentation. Image segmentation of microscopic blood cell images are done to locate the WBCs structure which are abnormal. Segmentation of images means partitioning the image into a set of pixels. A novel cell detection method which uses both intensity and shape information of blood cell to improve the nucleus segmentation was proposed. Accuracy of feature extraction of images is depends of proper segmentation of white blood cells using FCM. WBCs segmentation means segmentation of nuclei of abnormal cells. In leukemia patient white blood cells possesses abnormal structure of nuclei.

EDGE DETECTION

Edges in images are regions with very high contrast in intensity of pixels; detection of edges reduces the amount of data, filters useless information and preserves important structural details. Mean Shift segmentation is prominent edge detection operator which creates images emphasizing the edges and transitions.

FEATURE EXTRACTION

An image feature is a distinguishing primitive characteristic or attribute of an image. Some features are natural in the sense that such features are defined by the visual appearance of an image, while other, artificial features result from specific manipulations of an image. Natural features include the luminance of a region of pixels and gray scale textural regions. Image features are of

major importance in the isolation of regions of common property within an image and subsequent identification or labeling of such regions. Feature extraction in image processing is a method of converting large amounts of unnecessary data into a reduced data display. The process of converting input data into a property dataset is called feature extraction. Feature extraction methods analyze objects and images to extract the most distinctive features representing various object classes. Property vectors are used as input parameters to classifiers assigned to the class to which they are represented. The purpose of feature extraction is to reduce the original data by scaling certain properties or properties that distinguish an input set from another set. Feature extraction is an important process in the automatic classification of white blood cells and the selected properties affect the performance of the classifiers. The accuracy of the classification depends on the number of features, and feature properties. Features of WBCs are extracted to decide whether the cell is blast or normal. The Sober method with FCM (Fuzzy C-means clustering) is used for detection and feature extraction of blood cells.

ABNORMALITY DETECTION

The last stage involves abnormality detection. This includes recognition which is the process that assigns the label to an object based on the information provided by its descriptors. Interpretation is also included which involves assigning meaning to an ensemble of recognized objects. In terms of this project identifying the object as WBCs requires associating the descriptor for that object with label WBC. Interpretation attempts to assign meaning to a set of labeled objects. For example in case of leukemia , counting the number of WBCs in the image and then comparing it to the normal count of WBCs can help us to detect abnormality in the blood cell from which we can conclude that the patient has leukemia or not.

3.2 ADVANTAGE:

- Accuracy is high
- High reliability
- There is no chance of error occurrence.
- Speed of output extraction is fast.

4. RESULT AND DISCUSSION

In the project work, the experiments are carried using Matlab coding. We have prepared a GUI layout with a list of menus. Clicking on each menu will perform an independent function.

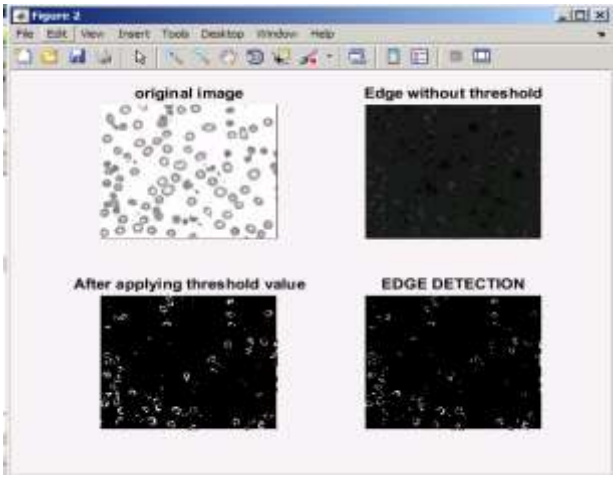

Fig.4 Segmentation

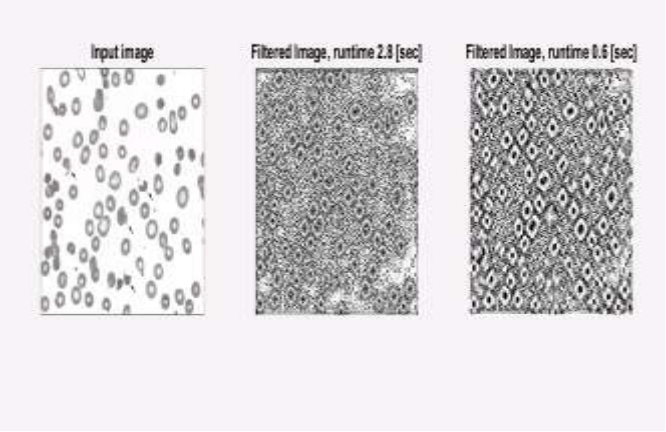

Fig.5 Feature Extraction

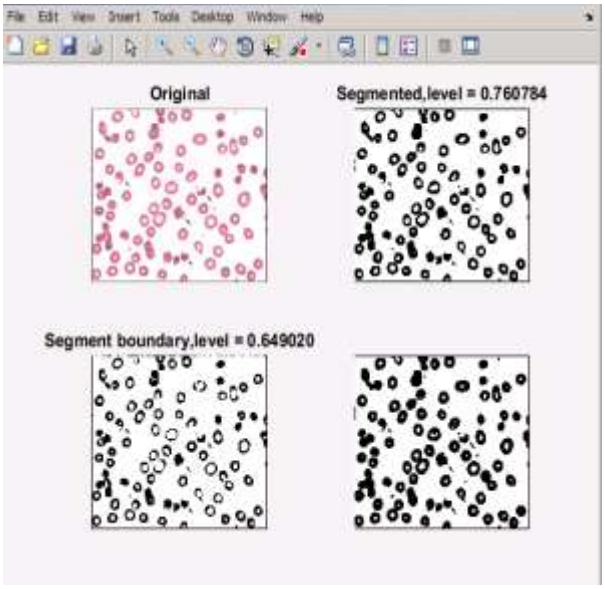

Fig.6 Classification

5. CONCLUSION

The purpose of this method was to implement image processing techniques in deciding presence of leukemia in white blood cell images.. Feature extraction part is implemented using FCM which gives better results even there is changes in input variation.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.

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