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FUZZY INFERENCE SYSTEM BASED CANCER CELLS DETECTION USING DIGITAL SIGNAL PROCESSOR- TMS320C6713

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Abstract - Human being suffers from various infections due to which the differential count of the various types of white blood cells (WBC) in bone marrow smears is used to detect tuberculosis, cancer, infection, koch's, anemia, and leukemia to accelerate the processes during treatment. However, locating, identifying, and counting the different classes of WBC such as Esinophils, leukocytes ,Lymphocytes, basophils, neutrophils manually are tedious and time consuming and slowers the task that could be accelarated by means of an automated analysis, in which segmentation of leukocytes image is a crucial step. This paper proposes a Fuzzy Inference System (FIS) based approach for detecting edge within color images obtained from microscope, which is robust for variable illuminant conditions, and takes into account color components stability degrees. For each image pixel we get the similarity degree between its color and the system colors, and makes algorithm design much easier and increases .The curiosity of experts for image edge detection skills. The above fuzzy rule base is then analyzed on floating Digital Signal Processor TMS320C6713 is a floating point processor, with 32-bit integer support and provides faster real time implementation.

Keywords- Fuzzy Inference System; Esinophils; leukemia: Lymphocytes; Digital Signal processing (DSP); Edge detection

I. Introduction

Leukaemia is a type of cancer that affects the white blood cells. In leukemia, white blood cells become abnormal, and divide(scatter) and grow in uncontrolled way. They enter in the blood and keep reproducing in an uncontrolled way. These abnormal white blood cells mix up in the blood and prevent it from making enough red blood cells,platelets counts. This means the body immunity reduces ,andis not able to fight off infections.

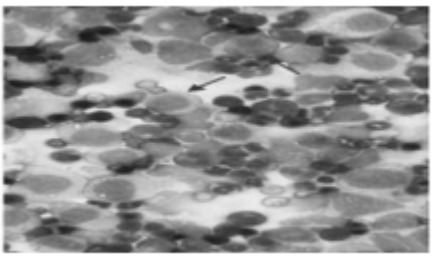

Figure.1 Lymphocytes Image

The abnormal white blood cells also prevent blood from making enough red blood cells and platelets. A lack of red blood cells leads to lack of oxygen being delivered to the organs and tissues of human body (Fig.1).

This results in anaemia, and it can make human-being feel tired and breathless. A deficiency of platelets may lead to problems in blood-clotting system, and results in bleeding and bruising much more easily than usual [1].

There are various types of WBCs (also called leukocytes) present in blood smear images. A differential count of these various types of cells determines the relative percentages of each one of them in the blood, notices presence of any abnormal appearance of the cells. and the presence of any abnormal immature cells. This differential count can be used to detectcancer, tuberculosis, infections, anemia, and leukemia which helps to follow the progress of treatment. Because any infection or acute stress results in increased generation of WBCs. This usually helps for an increases number of cells and an increase in the percent of immature cells (mainly band cells) in the blood. If WBC counts is high , indicates the presence of an provocative and immune response or it may result from other conditions such as leukemia.

An increase in one type of leukocytes will produce similar decrease in the quantity of other types. In order to locate, identify, and counting the different types of WBC manually is a tedious tasks mechanisms for automating this activity have been investigated. Besides relieving the already time intensive job from the technologist, an advantage of automation is saving of time so that largenumber of cells can be inspected, giving satisfactory better statistical and clear information in the differential counts.

Edge detection of blood cell images is a very the first step in automatic cell analysis, as the success of the final classification depends only on the correct edge detection , also there is considerable uncertainty in the microscopic images. The matured classes of the white blood cells actually represents a range, and cells repeatedly overlap each other, results in staining and illumination

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inconsistencies.There is wide variation of size and shape of nuclear and cytoplasmic regions within given cell classes. This uncertainty makes bone marrow image edge detection a difficult and competitive problem.

The most primitive practical-oriented effort in WBC recognition on smear images was carried out by Miller [3]. Later efforts have been focused on diverse aspects of segmentation of smear images and WBC differentiation.Wermeser et al. [4], introduces a hierarchical procedure using a priory information regarding chromatic properties of background and cell properties. Cseke [5] investigated the multi-step segmentation scheme. which implements the automatic thresholding method proposed by Otsu [6].

Besides histogram thresholding, clustering [7], edge detection [8], and region growing methods are mostoften used. As these methods are final decision, they violate the Marr's Principle [9], because once a wrong decision has been made, it is difficult. if not impossible, to correct it. In [10] a fuzzy-based cell segmentation approach reliable with the Principle of Least Commitment [8] was developed. The proposed system provided very accurate segmentation results working on monochrome bone marrow images. although cells' boundaries were hazily located and differentiation between WBCs and similar cells was left over for ensuing phases.

On the other hand, in case of color images, problems introduced by color's low hue,saturation and color illumination have to be considered. Even though human experts emphasize that white blood cells can be differentiated with grayscale images, they use color bone marrow microscopic images to carry out this analysis. Otherwise, grayscale images requires less storage devices and processing time than color microscopic images, it is not actually a problem due to both the increase of the power of present-day computers and the simplicity of the proposed algorithm.

So, we propose a system stanch to whiteblood cells edge detection of color bone marrow microscopic images that deals with human-like perceptual color information, and makes easier to control the system behavior. To avoid colors low saturation and color illumination problems, proposed approach is based on a color image representation that prevents non homogeneity problems due to illumination and shadows, allowing color recognition process to be free of illumination. Moreover, the process is based on fuzzy techniques, so that the natural unpredictability of color data is well accommodated.[2]

II.Fuzzy Inference System

FIS system is the most acknowledged system used in developing fuzzy models. The output of the system is generally defuzzified resulting fuzzy sets are mixed using aggregation operator from the consequent of each rule of the input.

A single if-then rule is written as;

IF "X" is A, THEN "Y" is B

or in a mathematical form;

{IF (premise)i THEN (consequent)i }(i=1to N)

Where, A and B are linguistic values defined by fuzzy sets on the ranges; X and Y, respectively. The if-part of the rule "x is A" is called the antecedent or premise, while the then-part of the rule "Y is B" is called the consequent or conclusion. Fig. 2 shows the defuzzification method applied onto a fuzzy model based on three different condition

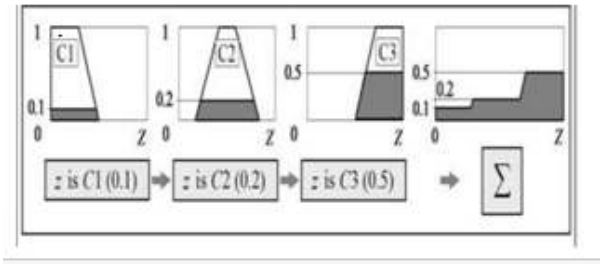

Figure 2.Defuzzification using FIS

Depending on the system, it is not be necessary to evaluate for every possible input combination since some may rarely or never occur. By making use of this type of evaluation done by an experienced operator, therefore fewer rules can be evaluated, thus simplifying problems in processing logic and perhaps improves the fuzzy logic system performance [12,13]

III Fuzzy-Based Edge Detection

The proposed algorithm explains is based on the selection of a set of three pixels, part of a 2x2 window of an image to a set of fuzzy conditions which help to highlight all the edges that are associated with an image. This fuzzy conditions help to test the relative values of pixels which is present in case of presence on an edge of cell. So the relative pixel values are instrumental in extracting all the edges linkedtoan image

A. Fuzzy sets and fuzzy membership functions

The working of proposed implementation involves by mapping the input image and the output image obtained after defuzzification and are both 8-bit quantized; this way, their gray levels are always between 0 and 255. The fuzzy sets are created to represent each variables intensities; these sets are associated to the linguistic variables "dark", edge and "light". The adopted membership functions for the fuzzy sets associated to the

input are trapezoidal and to the output are triangular, as shown in figures(3 and 4).

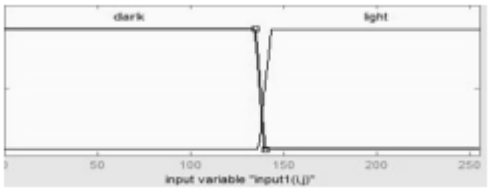

Figure 3: Membership functions of the fuzzy sets associated with each input

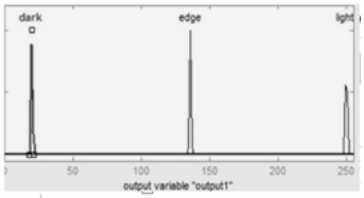

Figure 4: Membership functions of fuzzy sets associated output

The functions used for implementing the "and" and "or" operations are the minimum and maximum functions, respectively. The Mamdani method of fuzzy inference system is chosen as the defuzzification procedure, which means that the fuzzy sets obtained by applying each inference rule to the input data are joined through the add function; the output of the system is then computed with weighted average method of the resulting membership function. Therefore values of the three membership functions of the output are used to separate the values of the blacks, whites and edges of the image.

B.Inference Rules definitions

The procedure for implementing inference rules is to work on the weightage of the four neighboring gray pixels level, if the neighbors weights are degree of blacks or degree of whites. The powerful step of these rules is the ability to extract all edges in the processed image directly. This study is describing all the pixels of the processed image by studying the situation of each neighbor of each pixel. The condition of each pixel is decided by using the floating 2x2 mask which can be scanning all grays. In this location, some of the desired rules are explained. Since we have four pixel values as input, the total number of rules generated is sixteen. Out of the four input pixel values, if at least one input pixel value differs from the other three input pixel values then there is an edge. For example, if three pixel values are light and the fourth one is dark, then there is an edge in between them.

IV. Implementation Using DSP TMS320C6713

The TMS320C6x are the first family of DSP processors in DSP applications to use velocity architecture, having implemented the VLIW architecture. The TMS320C6213 is a 16-bit fixed point processor and the „67x is a floating point processor, with 32-bit integer support. The C6713 DSK is very low-cost standalone development platform which enables users to evaluate and develop applications for the TI C67xx DSP family. The DSK also serves as a hardware reference design for the TMS320C6713 DSP [11]. CCS provides an IDE to incorporate the software tools. CCS includes tools for code generation, such as a C compiler, an assembler, and a linker. It posses graphical capabilities and supports real time debugging. The C compiler compiles a code written in C program with extension .c to generate an assembly source file with extension .asm. The function of assembler assembles assembly language code to an.asm source file to produce a machine language object file with extension.obj. The linker combines the object files and object libraries as input to produce an executable file with extension .out. This executable file represents a linked common object file format , popular in Unix-based systems and adopted by several makers of digital signal processors. This executable file is loaded and run directly on the C6713 processor. A linear optimizer optimizes this source file to create an assembly file with extension .asm (similar to the task of the C compiler).

In our work we have develop a program of FIS algorithm using C program. After writing the code, the next step is to compile the code to machine language. The Build command will compile all the files that are include in this project and make an executable file for the DSP. Finally, to run the program, load the executable file (.out) that the compiler generated into the DSP and run the file loaded into DSP. The generated output of DSP is then open in image processing tool box.

V.Experimental Results

The algorithm begins with reading an MxN image. The first set of three pixels of a 2x2 window are selected with central pixel having values (1,1). After initialization, the pixel values are subjected to the FIS conditions for edge existence. After applying pixel values to the fuzzy conditions the algorithm generates an intermediate image. It is checked whether all pixels have been checked or not, if not then first the diagonal coordinate pixels are checked. If all horizontal pixels have been checked the diagonal pixels are checked else the diagonal pixel is incremented to retrieve the next set of pixels of a window. In this way the window is shifted and checks all the pixels in one horizontal line then increments to verify the next vertical location

Then image is fed to another set of condition after edge is highlighted because of which the unwanted parts of the output image are removed to generate an image which contains only the edges of lymphocytes cells associated with the input image.

Leukemia can be diagnosed from a blood test to measure the number of blood cells and look for any abnormal cells. Slides of blood sample are prepared and observed under the microscope to detect abnormal shaped cells such as kidney shape. Or the blood sample is detected for presence of immature cells in bone marrow. People with suspected leukaemia are referred to a specialist doctor, usually a haematologist (an expert in the treatment of blood disorders). Radiotherapy, chemotherapy and some other techniques are used for treatment of cancer.

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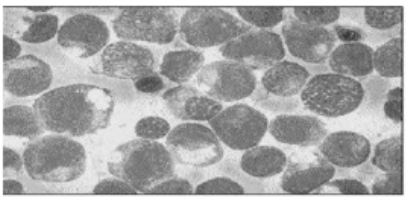

Figure 6 lymphocytes cells Image

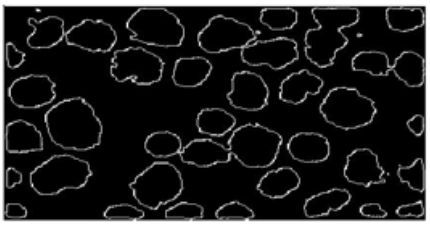

Figure 7 Edge Detected Image

As observed from figures 5, 6 and 7 it is observed FIS approach for the edge detection are quiet continuous , which helps to detect exact shape of white blood cells and direct report may be given whether a person is cancer infected or not.

VI. Conclusion

A new algorithm to detect the edges cancer cells associated has been introduced which has been instrumental to shorten the concepts of artificial intelligence and digital image processing. The FIS algorithm which has incredible scope of application in various areas of medical image processing. The image edge detection using FIS algorithm has been successful in obtaining the edges of the cancer affected cells that are present in medical images. FIS is implemented on TMS320c6713 DSP kit. Outputs have been shown to make to understand the accuracy of the algorithm and which helps to detect exact shape of cancer cells.

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