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Diagnosis of Leukemia Cell from Microscope Images Based on Wavelet Transforms

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***Abstract* – In this study, an efficient image processing algorithm is designed to recognize acute lymphocyte leukemia (ALL) cells, which are more common in children, have a high chance of treatment and can result in death if untreated. SVM (Support Vector Machine) is used as the method. Pre-processed with Wavelet Transform. The results were statistically analyzed with the help of Confusion Matrix. The rate of success was found to be 93.92%.**

***Keywords* – Leukemia Cell, Wavelet Transforms, Support Vector Machine and Confusion Matrix.**

I. INTRODUCTION

The wavelet transform method was developed by the Bulgarian mathematician Alfred Haar and the Belgian mathematician Ingrid Daubechies. It is one of the most popular methods used in the last 25 years. Image methods are often preferred. Apart from this, cumin is also used effectively in various image processing applications such as recognition of image, recognition. The acquisition of a wavelet transform of a function is obtained by determining the wavelet coefficients by dividing that function into different resolutions. For this process, a function called the main wavelet is correlated with the function to be transformed at different times and widths, and corresponding wavelet coefficients are obtained.

In two-dimensional signals, wavelet transform is performed by passing a series of low and high pass filters in a repetitive manner. Each filtering provides summary and detail coefficients at a different resolution for the image. This process can continue until the image is reduced to a single pixel. Mathematically two-dimensional wavelet transform is expressed as follows.

$$W_\varphi(j_0,m,n) = \frac{1}{\sqrt{M.N}}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)\varphi_{j_0,m,n}(x,y)$$

$$W_\varphi^i(j_0,m,n) = \frac{1}{\sqrt{M.N}}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} f(x,y)\varphi_{j_0,m,n}(x,y), i = \{H, D, V\}$$

$$f(x,y) = \frac{1}{\sqrt{M.N}}\sum_{x=0}^{M-1}\sum_{y=0}^{N-1} W_\varphi(j_0,m,n)\,\varphi_{j_0,m,n}(x,y) + \frac{1}{\sqrt{M.N}}\sum_{i=H,V,D}\sum_{j=j_0}^{\infty}\sum_{m}\sum_{n} W_\varphi^i(j,m,n)\varphi_{j,m,n}^i(x,y)$$

The block diagram of any resolution wavelet transform process is expressed as.

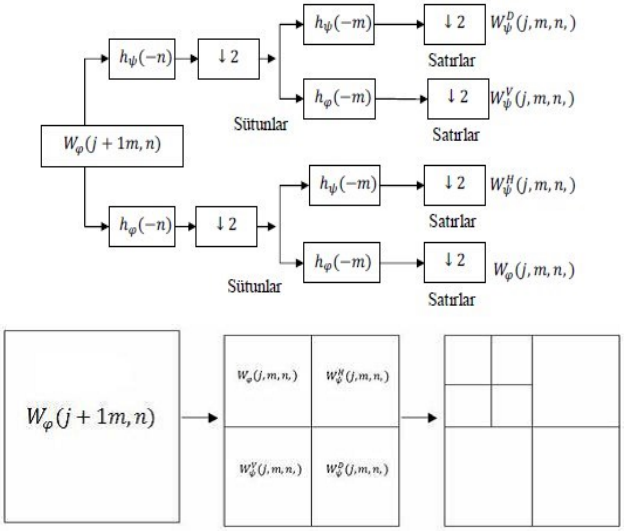

Fig. 1. Two-dimensional wavelet transform block diagram and matrix representation

Here
HL: changes along the x-axis,
LH: refers to the changes along the y-axis.

The power is smaller in the LL band. For coding, the low frequency band and the lowest bit of the high frequency band or their zero sets are used. In addition to the two-axis image parsing, the decomposition method is described along the natural edges of the image [39], [40].

Wavelet transform is a widely used method for processing medical images as well as many images. The application of the wavelet transform to an image block is given in FIG. The end result on the microscope image with chronic leukemia cells is as shown in Fig.

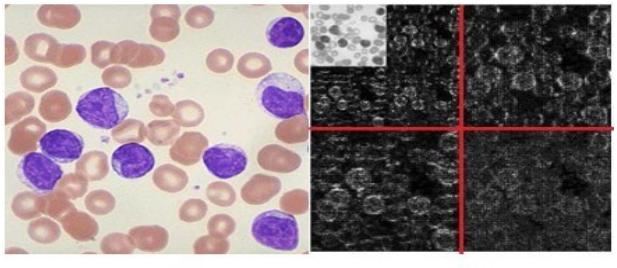

Fig. 2. Application of the wavelet transform to the leukemia cell. (A) Original leukemia cell image (b) Wavelet transformation result.

In the algorithm that is related to the diagnosis of leukemic cells, it is observed that the best results obtained from several iterative experiments are provided by Wavelet transform. Therefore, before using the Support Vector Machine, the 260 handwritten Wavelet transforms are applied.

3.3. Conversion of Image Color Scale

The images have been converted from RGB (Red, Green, Blue) to gray level in order to be able to read better and choose between only two colors.

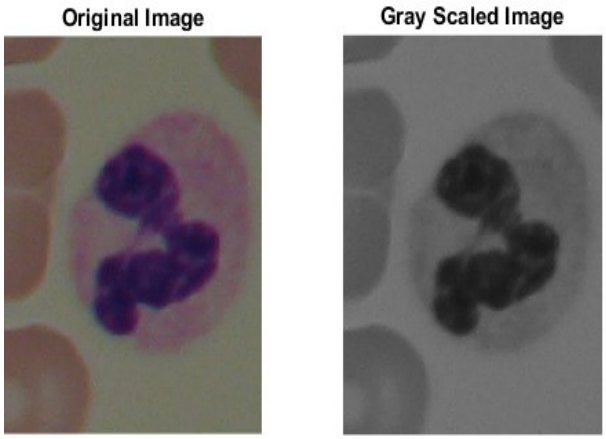

Fig. 3. An image with a changed color scale

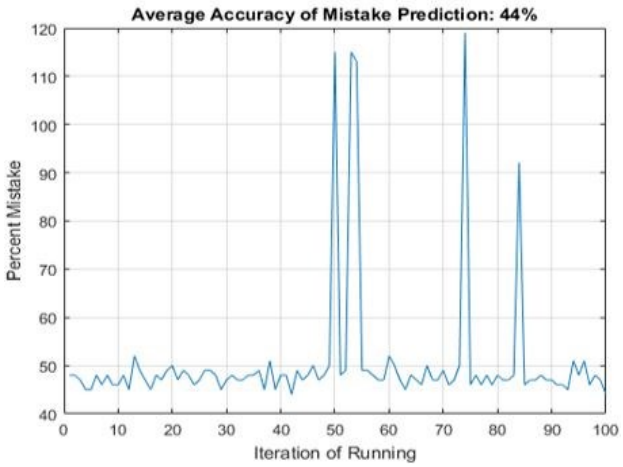

Fig. 4.

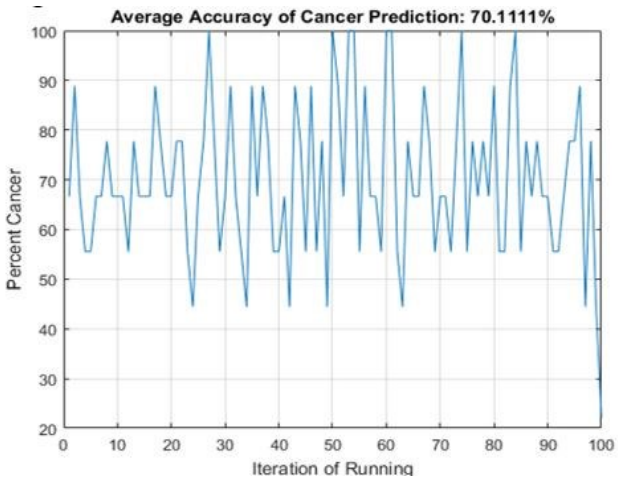

Fig. 5.

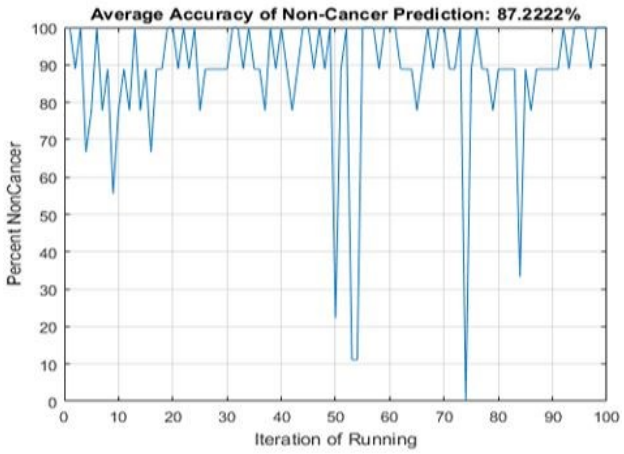

Fig. 6.

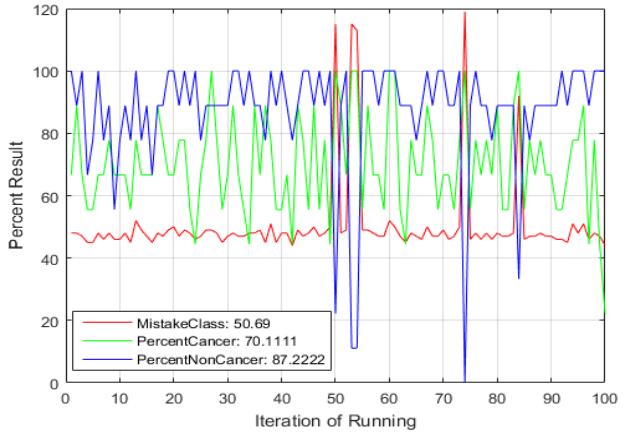

Fig. 7.

II. CLASSIFICATION

In the classification process, 130 healthy and 130 cancer cells Support Vector Machine (SVM) were used. It is possible to separate two groups by drawing a boundary between the two groups in a plane for classification. The place where this boundary will be drawn is that the two groups should be the farthest away from their members. Here SVM determines how this boundary is drawn.

In order to do this, two near and two parallel border lines are drawn on the two groups and the boundary lines are drawn closer together to produce a common boundary line. Patients and healthy cells are separated in this study. An example of SVM classification is shown in Fig.

In this way, two groups are shown on a two-dimensional plane. It is possible to think of these planes and dimensions as properties. In other words, a feature extraction is performed on each input that enters the system in a simple sense, resulting in a different point showing each input on this two-dimensional plane. Classification of these points is the classification of inputs according to the properties that have been extracted.

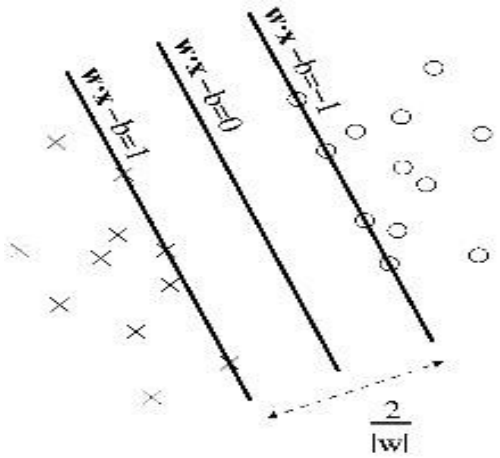

Fig. 7.SVM Classification

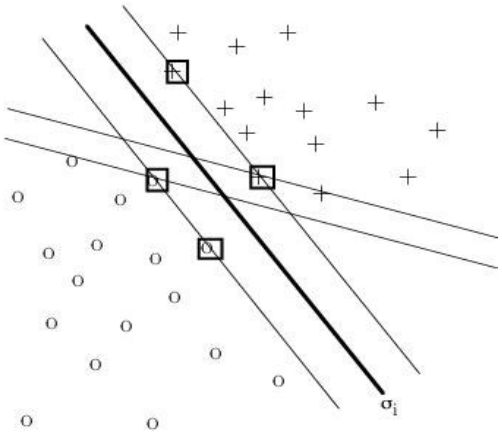

Fig. 8. It appears that hyperplasia is not unidirectional.

It is possible to say the tolerance (offset) between the two classes above. The definition of each point in this plane can be made by the following notation:

$$\mathcal{D} = \{(x_i, c_i) | x_i \in \mathbb{R}^p, c_i \in \{-1,1\}\}_{i=1}^{n}$$

It is possible to read the above display as follows. For every x, c, the vector X is a point in our space and c is the value that indicates that this point is -1 or +1. This set of points goes up to i = 1 '.

In other words, this representation refers to the points of the previous form.

If we think that this demonstration is on a hyperplanar. Every point in this display:

$$wx - b = 0$$

It can be expressed by the equation. Where w is the normal vector with the hyperplane perpendicular, x is the variable of the dot and b is the shear rate. It is possible to compare this equation to the equation for classical ax + b.

Again according to the above equation b / || w || the value gives us the distance difference between the two groups. We have already given the tolerance (offset) to this distance difference. In order to obtain the highest value of the distance according to this distance difference equation, 2 / || w || in the equation giving 3 straight values having the values 0, -1 and +1 shown in the first figure above Formula is used. That is, the distance between the lines is 2 units.

The two right equations obtained according to this equation are:

$$wx - b = -1$$
$$wx + b = 1$$

Actually, these equations are a result of finding the highest values obtained as a result of shifting the truths. It is also assumed that the problem is linearly seperable with these equations.

As expected, it is not possible for the hyperplaning between the two groups to be unidirectional. Here is an example of this situation:

Although there are two possible hyperplane possibilities in the above, the SVM method takes the one with the greatest tolerance (offset) from these probabilities. Thus, classification is made.

III. Conclusion and Evaluation

After the morphological preprocessing, the support vector machine (SVM) was used to construct the image processing algorithm and the most effective one among the different iterations was selected.

Of the iteration values read in Table 1 is the success rate we achieved when we first started. The second is the state after the Wavelet Transformation is applied. 3. Water is found by reducing and multiplying test and training data, where test data is reduced and training data is increased, the result is changed. This iteration constitutes a total of 260 data nodes, 120 adjective test data and 140 adjective data when the 10th address is called. With these results, it is observed that 93.92% of the network performance is achieved when the program is run.

Table 1 Iteration results

1	71.8170
2	81.0551
3	83.2600
4	84.1394
5	84.8377
6	84.8386
7	85.2580
8	87.8305
9	88.5114
10	93.9154

After running the algorithm with random data, the achieved rate is 93.9154. After these operations are performed 100 times in the algorithm randomly, the community average is calculated as 96.43%. Early recognition for ALL disease is known to result in favorable outcome. The result shows that this method successfully solves the problem of diagnosing acute lymphocyte leukemia cells with the help of SVM after morphological pretreatment.

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