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Medical image processing using fractal functions

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ABSTRACT

In this paper, a comparison was made between a modified methods for repeated engineering modeling in order to increase the accuracy of medical images. A comparison was made between different types in terms of classification accuracy. The lacuinartiy feature has also been used to reduce the noise ratio in the received images. The results showed the importance of fractal IFS in medical pulse compression, where a ratio of (98%) was obtained in reducing noise and a ratio of (0.421) in the gap coefficient was obtained. It separated the diseased tissues from the healthy tissues by applying several multi-fractal factors. Fractal image compression is dependent on subjective similarity, with one part of the image being the same as the other part of a similar image. The partial coding is constantly linked to the grayscale images by dividing a color RGB image into three channels - red, green and blue, and is compressed independently by considering each color segment as a specific gray scale image. Based on the smart neural network, the patterns are distinguished for the medical images used by a few learning time and positive error 0.22%.

Keywords: fractal, medical images, filter, classification, Iterated Function System (IFS)

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1. Introduction

B. Mandelbrot's invention of fractal geometry came before Michael F. Brandley's discovery of fractal transforms in 1988. During the period 1875 to 1925, mathematicians were aware of some of the fundamental elements of fractal geometry, but they believed that this experience was unimportant[1]. In the 1960s, Mandelbrot, an IBM mathematician, was the man who pioneered this area of mathematics in detail. In 1975, he published his first paper on fractal theory[2].

Fractal forms can be found anywhere in nature. Coastlines, lungs, landscapes, tumultuous water flow, and even the erratic fluctuation of prices on the Chicago commodity exchange [3]were all recognized by Mandelbrot.

Fractals require three parameters to define the shape: "complicated structure on a broad range of scales, replication of structures at different length scales (self-similarity), and a 'fractal dimension' that is not an integer." [4]Specifically, an idealcompressed calculation is looked for compacting image. This is wanted so as to spare extra room, just as time. Contingent upon the reason for the image, one would either need to store the very same information as in the first image (this is called lossless

coding) or a compacted form of the information (alluded to as loss compressed). For example, one may wish to store a clinical image without loss of information. Notwithstanding, media conferencing requires snappy "ongoing" transmission forimage, requesting some type of compressed [5].

1.1 Iterated function system (IFS) fractals for fractal image compression

The IFS compressed calculation begins with some objective image T which lies ina subset the objective image T is delivered on a PC designs screen. So as to start fractalimage compressed, a relative change[6],

$$W_1(x) = W_1\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} e \\ f \end{pmatrix} \qquad (1)$$

$$X_n = F(X_n - 1) = \sqrt{X_n - 1} = Xo^{\frac{1}{Z^n}^2} \qquad (2)$$

Presented with coefficients that produce another image, with measurements more modest than that of T. This guarantees a compression planning. The client changes thecoefficients a, b, c, d, e, f so as to contract, decipher, turn, and shear the new image, , on the screen so it lies over a piece of T. Once is set up, it is fixed, the coefficients arerecorded, and another relative change is presented alongside its sub-duplicate of T. A similar cycle is completed with this new image as was finished with [7]. At whatever point potential, covers between and ought to be evaded. Covers just entangle the circumstance, in spite of the fact that there exist ccompressed strategies, for example, wavelets, which face this issue [8]. A bunch of relative changes is acquired with the end goal that as shown in Figure 1.

$$\breve{T} = \underset{n-1}{\overset{N}{U}} W_n(T) \qquad (3)$$

Where N is as little as could be expected under the circumstances .

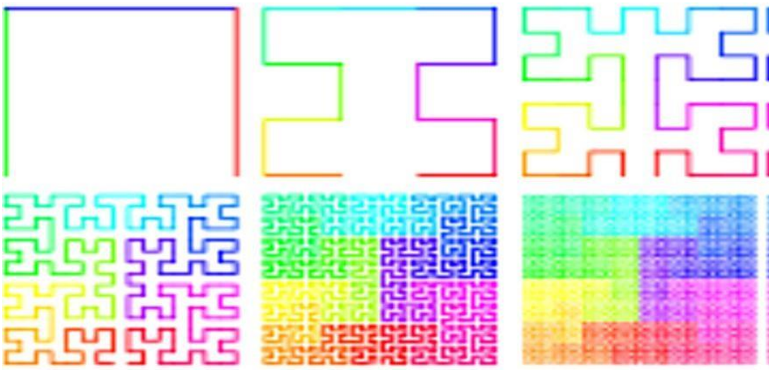

Figure 1. IFS) fractals for fractal image compression

The Collage Theorem ensures that the attractor a f this IFS would be externally near (T). In addition, if that is the case, then. Using a small number of ones and zeros, a produces a picture that is outwardly close (T) and target autonomous. We can regulate the attractor of the IFS by changing the boundaries in the changes. This is how fractal image compression[9] works.

Complex image can be developed utilizing fractal image compressed by chipping away at subsets of the image, where every subset is spoken to by an IFS. This strategyfor compressed is profoundly ideal. In the event that every coefficient in the relative changes portraying the IFS is spoken to with one byte, at that point an IFS of three changes requires just (12) bytes of information to speak to its image. As the quantity ofcoefficients utilized expands, the size of the computerized document increments.

Subsequently, it is ideal to discover as barely any relative changes as conceivable to speak to a image. For an inside and out investigation of how to enhance the capacity ofinformation in records see [10].

1.2 Artificial neural network ANN

It is an Artificial Neural Networks (ANN), a system for processing data in a way that simulates and resembles the way natural neural networks do for a person or a livingbeing [11] as shown in Figure 2. The process of differentiation using a neural networkgoes through two stages: the training process, and testing stage.
A. Training process: The training process is important in determining the extent ofsuccess or failure the process of distinguishing and we need before the training processto create a database for the artificial neural network to be trained on, and part of the database must be devoted to the purpose of conducting an operation [12]. The test to assess network efficiency did you learn or not, In order to conduct the training, you must first choose.The general structure of the neural network by defining the inputand output layer and the number of hidden layers, And when designing the general structure of a network[13], the number of input cells must be equal to the number of vector elements.

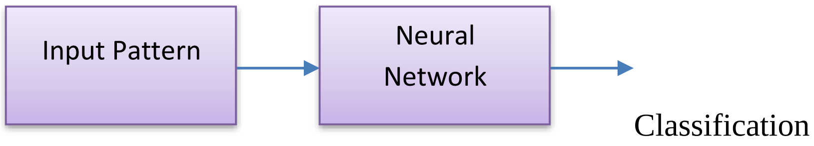

Figure 2. shown the classification in ANN

The input is from the merit distraction, and the number of output cells is equal to the number of the intended speakers Distinguish them, and the choice of the number ofhidden layers is entirely trial and error [14]. And in some Applications We do not needhidden layers but only an input and output layer, and that depends on the type of application used. A stimulus function must be defined for each stratum, either similar or different, and from Which greatly affects the important transaction process in training education ratio coefficient Training[15], as it is chosen for a higher value atthe beginning of training and then decreases after that as the choice is not Fitting it reduces the efficiency and speed of the network, and there is another factor that is no less important than coefficient (Target) Education is the (acceleration) frequency factor that helps speed the achievement of the goal [16]Learning percentage factor and frequency factor play an effective role in controlling weights.

Testing process: This is an important process for assessing the efficiency and capacity of the network to operate The distinction is directly related to the training process, and after training the network is ready To distinguish it, then comes the testingphase, so the part of the testing process is taken from a base Pre-configured data, as thefeature vector value is as an input to the neural network, and if not Training[17], the process is repeated, either by increasing the number of frames from the feature extraction vector[18], or by changing Learning parameter and fixing the repetition process, or by changing the iteration process and fixing the learning parameter, or Bothtogether, and this is changed until the desired (target) output is obtained, then stopped[19] [Training and a test process is conducted to measure network efficiency[20].

1.3 Histogram shrinking

Histogram is defined as a graph of the values for the corresponding gray levels The number of pixels at that value. The histogram appears as a graph with "brightness" horizontally. From 0 to 255. So the graph shape provides us with information aboutnature .An image or a sub-image if we look at an object within the image. The datacan be shrunk without affecting the features of the image as shown in the Figure 3 and Equation (4).

$$stretch(I(r,c)) = I(r,c) - I(r,c)min / I(r,c)max - I(r,c)max \quad (4)$$

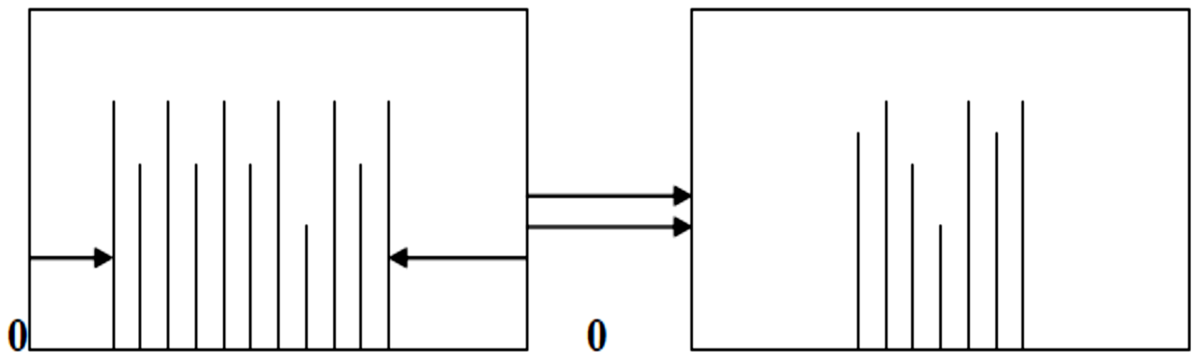

Figure 3. The reduce in histogram

1.4 Image quality

In order to determine the degrees of application of the quality standards in the results obtained through the arithmetic averages and the signal-to-noise ratio shown in the equations below. Image quality measurement is important in image processing such asenhancement, blur removal and noise reduction, as it can be used to evaluate the quality of the processed image**.**

1- PSNR (Peak Signal to Noise Ratio)

$$PSNR = 20 * \log10 (255/\sqrt{MSE}) \quad (5)$$

2- Average Square Error (MSR**)**

$$MSE = \frac{1}{W*L} (\sum_{P=1}^{q} \sum_{P=1}^{P} (OI_{pq} - EI_{pq})^2 \quad (6)$$

3 Normalized cross-correlation (NK)

$$Sc = \sum_{i=1}^{M} \sum_{j=1}^{N} (x(i,j))^2 / \sum_{i=1}^{M} \sum_{j=1}^{N} (x(i,j))^2 \quad (7)$$

2. Research method

After a square window has been determined N*N the highest value of the specified light points (x, y) is chosen. Figure 4 illustrates the main steps for implementing the program for the medical visualization models used. Matlab softwarecan be applied in compressing grayscale digital images that are as the desired range block size is specified by setting r size equal to the desired band block side length r size is set to 4, allowing for the block size range. The domain blocks, which are twice the size of the domain blocks, are then formed. We'll need to compare domain blocks and scope blocks to figure out what mapping to make from domain blocks to scope blocks.

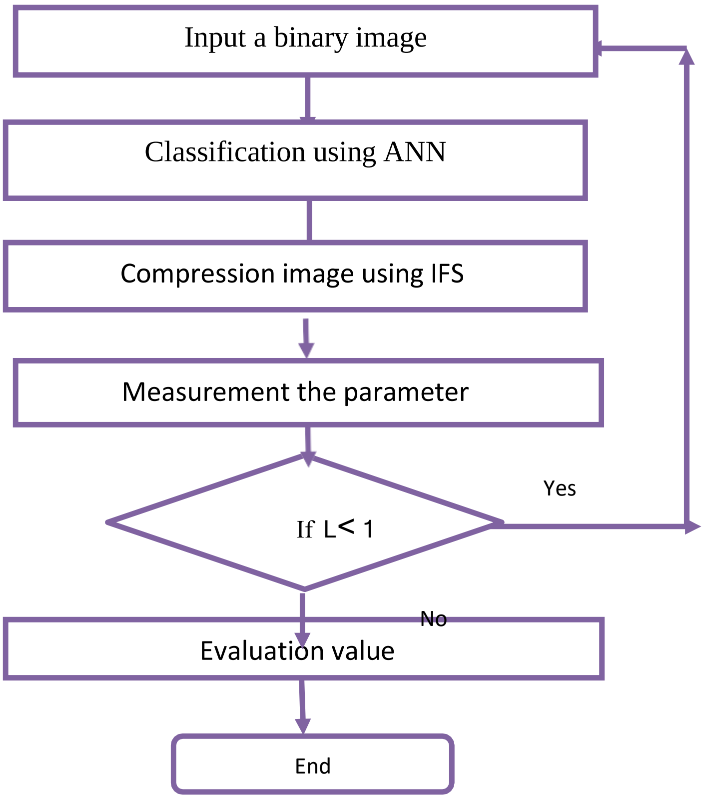

Figure 4. Directivity of the proposed antenna

These blocks must be the same size to be compared accurately. As a result, we perform some averages on the domain blocks, allowing us to reduce the size of the domain blocks to half their original size.

Only any distinct block of pixels within the block of field is averaged. After that, each pixel block's average grayscale value is expressed by a single pixel in the measured field blocks, which are referred to as M1. To calculate the likelihood of darkening the decompressed image, we subtract the average field mass from each entry in the field mass. The measured field mass as a result is (Dr).

The number of iterations applied to the raw image to arrive at the attractant image varies depending on the block size chosen for the band block. The attractant becomes more visible as more IFS iterations are added to the image. The image created is identical to the medical images, and the initial image's field blocks must be generated and resized to fit the domain blocks. The domain blocks are then transformed and mapped to the domain blocks using matrix T. For each iteration, the procedure is repeated. The M attractant is then output to be displayed for the original image, and the subsequent images are recreated after the local IFS iteration for that image is produced. The consistency of attractants varies by scope and the allowable error of an effective shift block from field to domain block.

Large compression ratios were obtained using the fractal compression process. Why is the compression ratio better than 5: 1 because each pixel takes 8 bits to store values ranging from 0 to 255? Increasing the scale block size to pixels, of course, increases compression to just 2,688 bytes, with a compression ratio of around 24: 1. The larger block sizes allow for a wider range of compression ratios. The amount of error allowed in the transitions determines how long it takes to create the picture of the attractant. The quicker the compression, the higher the error. The amount of compression and image quality needed will be determined by the image's intended use. The backpropagation neural network shown in Figure 6 and the weights shown in the matrix shown in Figure 7 are used to process distorted images (7).

The values of high contrast between the images of cells were calculated by calculatingthe Lacunarity and as shown in Equation (8).

$$\lambda_\varepsilon = \frac{\sum_{i=1}^{B} m_{i,\varepsilon}^2 p_{i,\varepsilon} - \mu_\varepsilon^2}{\mu_\varepsilon^2} = \frac{\sigma_\varepsilon^2}{\mu_\varepsilon^2} \quad (8)$$

where λ is Lacunarity, σ is probability distributionm: masses, and ρ is corresponding probabilities.

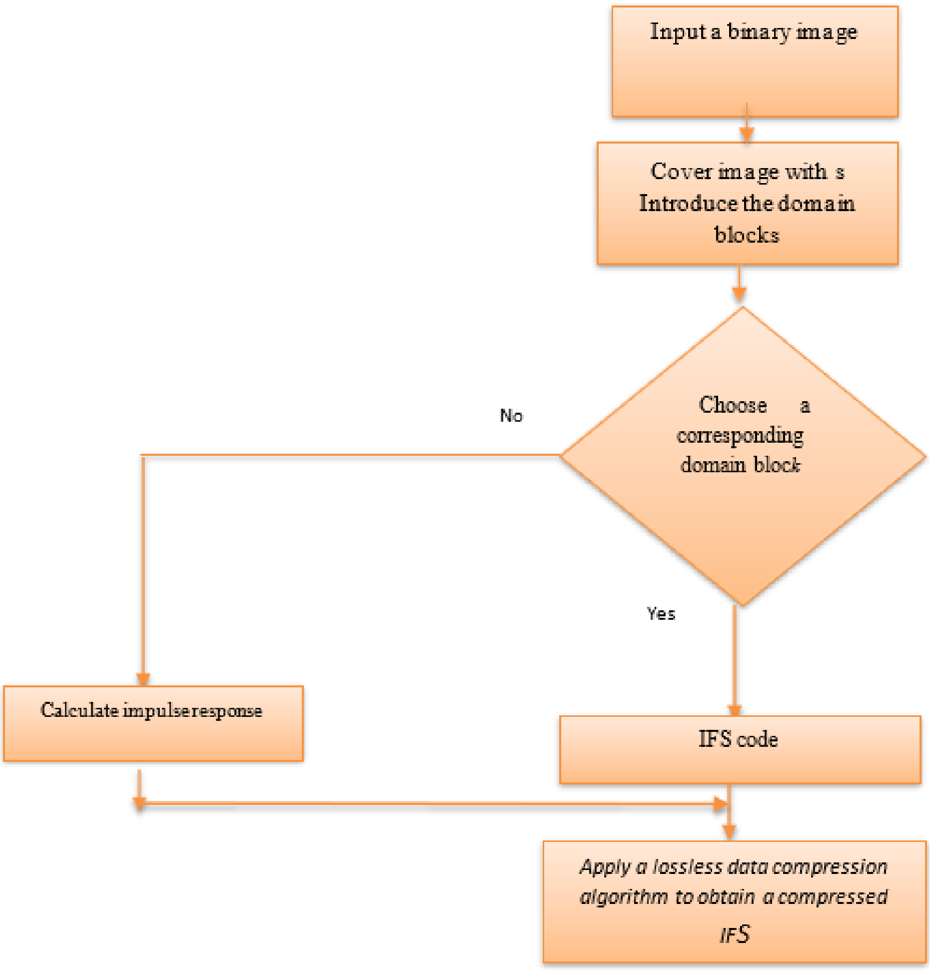

Figure 5. IFS fractals for Fractal Image Compression

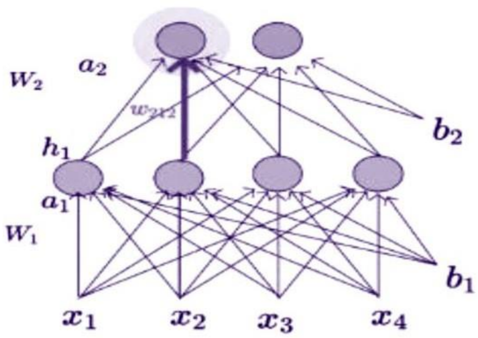

Figure 6. Backpropagation neural network

$$W_1 = \begin{bmatrix} 0.1 & 0.3 & 0.8 & -0.4 \\ -0.3 & -0.2 & 0.5 & 0.5 \\ -0.3 & 0 & 0.5 & 0.4 \\ 0.2 & 0.5 & -0.9 & 0.7 \end{bmatrix}$$

$$W_2 = \begin{bmatrix} 0.5 & 0.8 & 0.2 & 0.4 \\ 0.5 & 0.2 & 0.3 & -0.5 \end{bmatrix}$$

Figure 7. Matrix for weight

3. Result and dissection

First an image processing is performed that includes image enhancement, to increasecontrast, traits are then extracted for the entire training images, and these traits are usedIn addition to prior knowledge of the class number of training images, to identify positive spouses and negative. The model includes the application of the Artificial Neural Network. Either the retrieval of a certain number of medical images of the models of(3000) images for red blood cell classified into(20) classification, and the testing process of the image or its compression was carried out using the IFS fractal function.

- The results of classification using fractals were obtained compared to the results obtained from using other methods, as the results showed higher reliability depending on Collections of medical images (98%) compared to the result obtained using the program.
- Statistical treatment of the results obtained through multiple analyzes the use of fractals proved important
- The theory of IFS fractional image compression can be recreated using less storage space, since it is possible to produce similar sub-images, so the use of IFS will be more accurate and efficient in terms of storage space for the medical images used.
- The PSNR and MSE values for medical images, as well as the fractal form used in medical images, are shown in table (1) and table (2). PSNR is used to assess the nature of image remaking after lossy and lossy compression. The standard PSNR qualities in lost image compression are between 60 and 40 dB, with an 8-bit bit depth, with the higher the better. The histogram image depicts how pixels in an image are sliced, as well as the contrast between the first and last images after the submission. The most parameter and ratio compression in the fractal system is seen in the suggested technique for compressed table (3).
- By studying the texture images resulting from applying the dependent algorithms and methods For fractals, windows of smaller dimensions have been shown to be of greater benefit when applied to image have smooth textures, and windows with larger.
- dimensions are more useful. When applied to jagged textured images.the roughness of the tissue in the medical image has a great impact on the resulting texture image Regardless of its brightness or color.
- The contrast of poorly contrasted digital images has also been improved, and the color is well distributed, and the images are made brighter. The methods used are programmed using Matlab.

Table 1. Test results show number of samples of images = 100

Positive errors	Classification accuracy	Learning time
0.22%	98%	2.234

Table 2.Test results show number of samples of images = 50

Positive errors	Classification accuracy	Learning time
0.33%	98%	2.434

Table 3. Parameter and ratio compression in fractal method

Parameter	Mean value of 50	Mean value of 100
Dr	1.867	**2.964**
MSE	2.456	**2.582**
PSNR	0.421	**0.532**
M	1.745	**1.954**
Compressionratio	5:1	**24:1**
Lacunarity	**0.15**	**0.41**

After conducting many experimental tests, the number of features =100 for each sampleof images were chosen to be the entrances to the smart neural network. The number ofneurons in each of the hidden layers was chosen experimentally [2][8] where the results.

According to the matrix shown in Figure 7. Figure 8, Figure 9 and Figure 10 show the sample of medical images uses. To preserve the data, Histogram is applied to the samples used as shown in Figure 11.

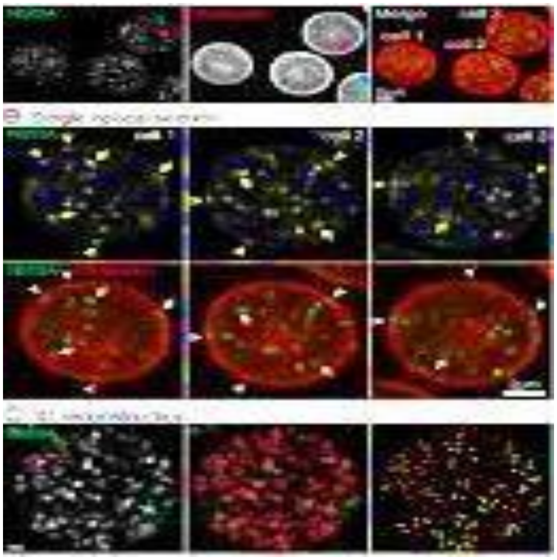

Figure 8. Sample of original images

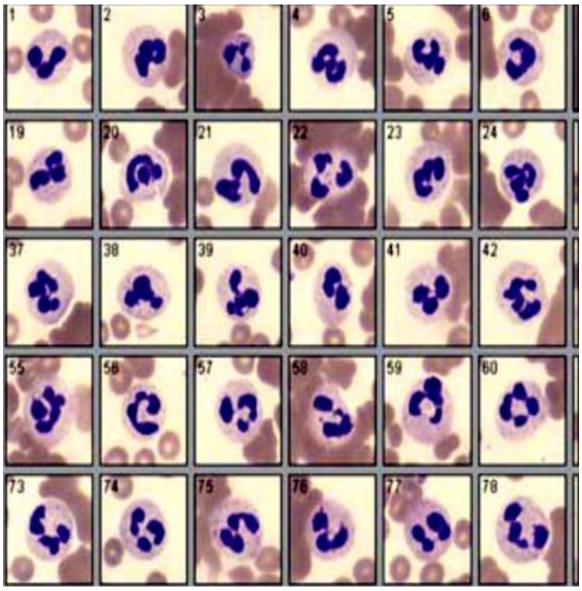

Figure 9. Sample of original images

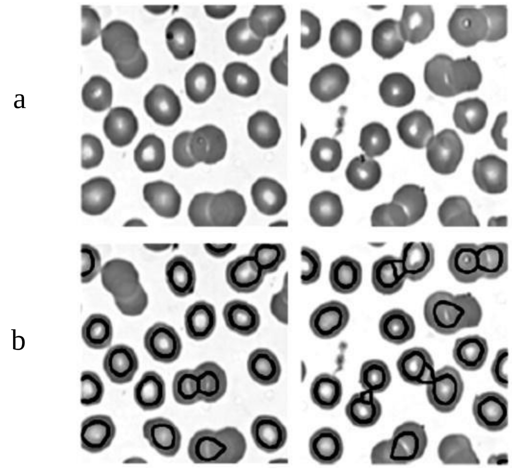

Figure 10. (a) Sample of original images, (b) data compression byIFS fractal

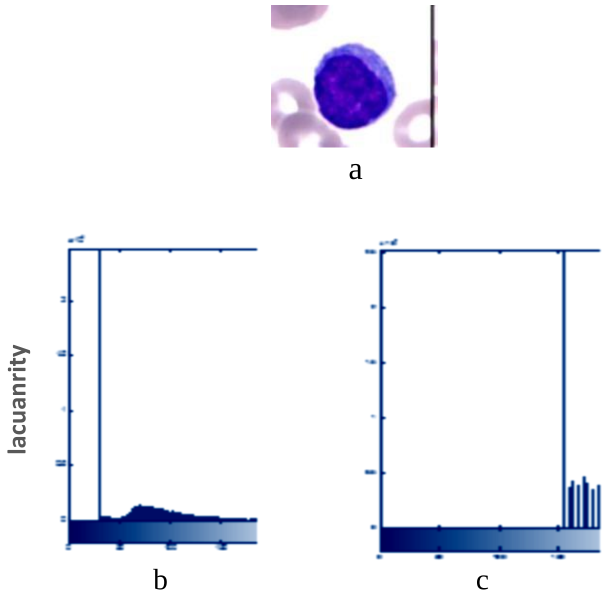

Figure 11. (a) Sample of original images; (b) Histogram of image; (c) Histogram shrinking

The image file size file is quite large compared to many other types of computer files because each pixel requires 24 bits (3 bytes) to store color information. Therefore, the files become too large to be stored easily, and in order to make the image files smallerand more manageable, we have to compress images, thus obtaining more storage and by displaying the results, the accuracy of the fractal method in the field of medical image compression has been obtained. Figure 12 shown the matrix of fractal dimensionscomputed for image.

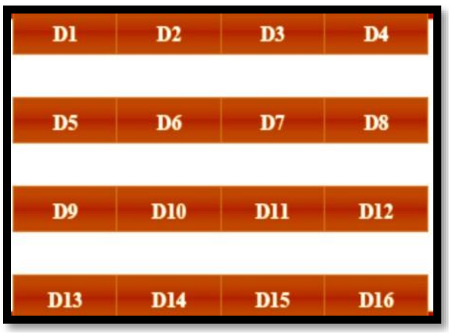

Figure 12. Matrix of fractal dimensions computed for image

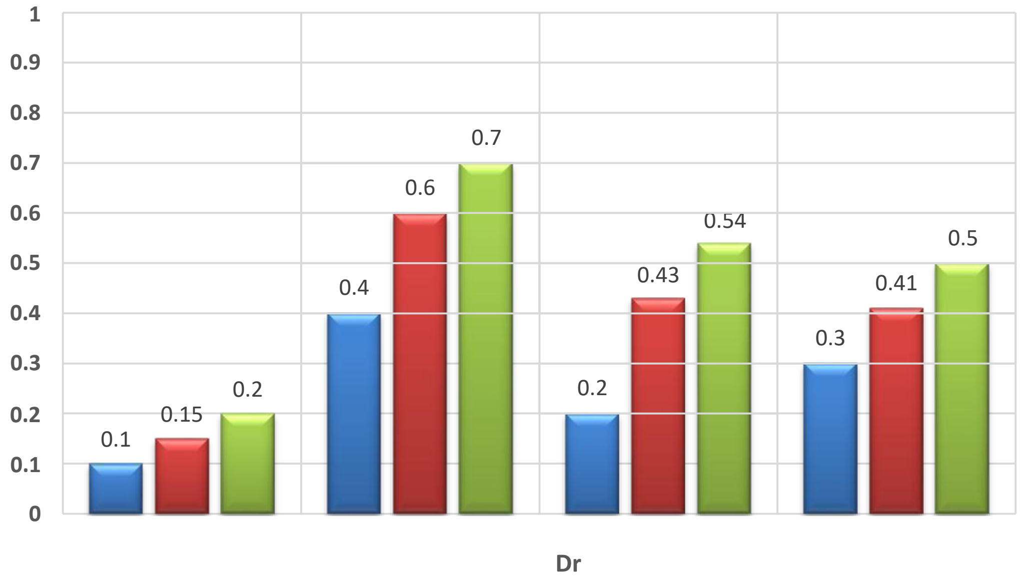

Figure 13. Matrix of fractal dimensions computed for image

And to measure differences in high contrast and rotational contrast, as well as distinguish and define subtle differences between infected cells and healthy cells, so that they can have important implications for studying cells. In the equation (8), the method of calculating the Lacunarity for all models applied in the research is shown inFigure 13.

4. Conclusion

Through the research, a set of conclusions were reached:

1. The fractal image compression algorithm that has been implemented is the most effective. Lossless code, such as compression (IFS), can enhance several compression algorithms in addition to optimizing compression for that data.
2. These non-lost icons may be preferred over lost compression methods in cases where data loss is minimal but image data and quality remain identical to the original image; however, in cases where precise data recovery is needed after compression, the lost icon is the better choice when using same way to measure.
3. Reliance on the neural network in training and with little learning time (2. 234) for the medical images used and positive error 0.22%.
4. Formats using fractal engineering (IFS) are faster and more efficient than other imagecompression techniques. A high image detection rate of 98% was obtained with an errorrate of less than 10%.
5. The concept of lacunarity (L) is defined as an important measure in the fractal function to define and clarify the concept of multiplicity of processes, especially in medical cell images that were used in the research.

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