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Image Segmentation using bi directional of neural network

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Abstract: - Now a days image processing methods are widely used in medical science, to improve critical disease detection and fast treatment for recovery. Mainly this mechanism detects the disease as soon aspossible and also find out the exact point of disorder and calculate the growth of this disease,especially in Squamous cell carcinoma in lower lip. Actinic keratosis which is 1/4 inch in diameter, isa pink or flesh coloured rough spot is one of the most important cause of squamous cell carcinoma,which is mainly grown in sun-exposed area. It is usually grow slowly and affects epidermis layer todermis layer. Our proposed method focuses on five different modules. These methods are including inImage Acquisition module and respective Pre-processing , Segmentation , Filtering Phase and Edge Detection modules.

Keywords: **-** *Image Clipping, Smoothing , Enhancement, Thresholding, Histogram Analysis*

I. INTRODUCTION

Image processing [3] is any form of signal processing for which the input is an image, such as photographs; the output of image processing can be either an Image or a set of characteristics or parameters related to the image. Most image processing techniques involve treating the image as array, or a matrix, or a square pixel arranged in column and row. In 8 bits grayscale image each pixel has assigned intensity from 0 to 255.Gray scale image is what people normally call black and white image, but the name emphasize that such an image also include many shades of gray.A normal grayscale image has 8 bit color depth=256 grayscales. Where as a true color image has 24 bit color depth=8 x 8 x 8 bits=256 x 256 x256= 16 million colors Digital image processing is the use of computer algorithms to perform image processing on digital images. It allows a much wider range of algorithms to be applied to the input data, and can avoid problems such as the build-up of noise and signal distortion during processing.

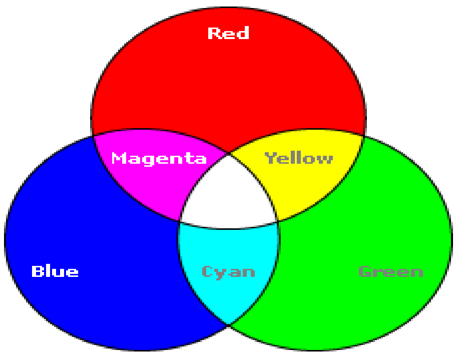
Digital image processing methods were introduced in 1920, when people were interested in transmitting picture information across the Atlantic Ocean. The various steps required for any digital image processing applications are listed

Below:-

I. Image acquisition
II. Preprocessing
III. Segmentation
IV. Representation and feature extraction
V. Recognition and interpretation

An image is digitized to convert it to a form, which can be stored in a computer's memory or on some form of storage media such as a hard disk or CD-ROM. This digitization procedure can be done by a scanner, or by a video camera connected to a frame grabber board in a computer. Once the image has been digitized, it can be operated upon by various image-processing operations.

Image defects which could be caused by the digitization process or by faults in theImaging set-up (for example, bad lighting) can be corrected using Image Enhancement techniques. Once the image is in good condition, the Measurement Extraction operations can be used to obtain useful information from the image.Image processing involves processing or altering an existing image in a desired manner. The first step is obtaining an image in a readable format. This is much easier today than five years back. Once the image is in a readable format, image processing software needs to read it so it can be processed and written back to a file. An image consists of a two-dimensional array of numbers. The color or gray shade displayed for a given picture element (pixel) depends on the number stored in the array for that pixel. It is a binary image since each pixel is either 0 or 1. People can distinguish about 40 shades of gray, so a 256 shade image looks like a photograph. This project concentrates on gray scale images and also color images. The most complex type of image is color. Color images are similar to gray scale except hat there are three bands, or channels, corresponding to the colors red, green, and blue. All though there is so many color model, but the RGB is the popular one Thus, each pixel has three values associated with it.It use additive color mixer and is a basic color model used in television and any other miduam that projects color with light.RGB color model also used in computer and for web graphics but it cannot be used for print production.the secondary color of RGB is cyan, magenta and yellow. A color scanner uses red, green, and blue filters to produce those values. Images are available via the Internet, scanners, and digital cameras. Any picture shown on the Internet can be downloaded by pressing the right mouse button when the pointer is on the image. This brings the image to the PC usually in a JPEG format. Your software packages can convert that to correct resolution. Image scanners permit putting common photographs into computer files.



II. DIGITAL IMAGEREPRESENTATION

The term monochrome or simply, refers to a two-dimensional intensity function *f(x,y)*,where x and y denote spatial coordinates and the value of f at any point (x,y) is proportional to the brightness (or the gray level)of the image at that point. Sometimes viewing an image functioning perspective with the third axis being brightness is useful. In this way as series of active peaks in regions with numerous changes in brightness levels and smoother regions or plateaus where the brightness levels varied little or were constant. Using the convention of assigning proportionately higher values to brighter areas would make the height of the components in the plot proportional to the corresponding brightness of the image. A digital image [5] is an image f(x,y) that has been discretized both in spatial coordinates and brightness. A digital image can be considered a matrix whose row and column indices identify a point in the image and the corresponding matrix element value identifies the gray level at the point .the elements of the digital array are called image elements, picture elements, pixels or pels, with the last two being commonly used abbreviations of "picture elements".Although the size of a digital image varies with the application, demonstrate the many advantages of selecting square arrays with sizes and number of gray levels that are integer powers of 2. For example, a typical size comparable in quality to a monochrome image is a 512 *512 array with 128 gray levels.

15	0	0	0	0	15
15	3	3	3	3	15
15	3	0	0	3	15
15	3	0	0	3	15
15	3	0	0	3	15
15	3	3	3	3	15
15	0	0	0	0	15

The above zoomed picture is a 6 X7 picture and its pixel value is written in a matrix form.
Here, x=7 and y=6.Then we can find f (2, 2) =3, f (4, 3) =0 and so on.
1 Simple image model

The term image [3] refers to a two-dimensional light-intensity function, denoted by $f(x, y)$, where the value or amplitude of f at spatial coordinates(x, y) gives the intensity (brightness) of the image at that point. As light is a form of energy $f(x, y)$ must be nonzero and finite that is,

$0<f(x, y)<\infty$.---(1)

The basic nature of f(x, y) may be characterized by two components:

(1) The amount of source light incident on scene being viewed.

The amount light reflected by the objects in scene. Appropriately, they are called the illumination and reflectance components, and are denoted by i(x, y) and r(x, y), respectively. The functions i(x, y) and r(x, y) are combine as a product to form f(x, y):

$f(x, y) = i(x, y)r(x, y)$ --(2)

where

$0<i(x, y)<\infty$--(3)

and

$0<r(x, y)<1$---(4)

Equation (4) indicates is bounded by 0 (total absorption) and 1 (total reflectance). The nature of i(x, y) is determined by the light source, and r(x, y) is determined by the characteristics of the objects in a scene. The values given in Equations (3) and (4) are theoretic bounds. The following average numerical figures illustrate some typical ranges of i(x, y). On a clear day, the sun may produce in excess of 9000 foot-candles of illumination on the surface of the earth. The figure decreases to less than 1000 foot-candles on cloudy day. On a clear evening, a full moon yields about 0.01 foot-candle of illumination. The typical illumination level in a commercial office is about 100 foot-candles. Similarly the following are some typical values of r(x, y): 0.01 for black velvet, 0.65 for stainless steel, 0.80 for flat-white wall paint, 0.90 for silver plated metal, and 0.93 for snow.

The intensity of a monochrome image f at coordinates (x, y) the gray level (l) of the image of the point. From equations (2) through (4), it is evident that l lies in the range

$L_{min} \leq l \leq L_{max}$

The only requirement on $L_{min} = i_{min}r_{min}$ and $L_{max} = i_{max}r_{max}$. Using the preceding values of illumination and reflectance, the values $L_{min}=0.005$ and $L_{max}=100$ for indoor image processing applications may be expected.The internal $[L_{min}, L_{max}]$ is called the gray scale. This interval numerically to the interval [0, L], where l=0 is considered black and l=L is considered white in the scale. All intermediate values are shades of gray varying continuously from black to white.

III. IMAGE PROCESSING

Digital image processing [7] encompasses a broad range of hardware, software and theoretical underpinnings and it will be helpful to use a ‘theme’.An application that is rather easy to conceptualize without any prior knowledge of imaging concepts is the use of image processing techniques for automatically reading the address on pieces of mail. The overall objective is to produce a result from a problem domain by means of image processing. The problem domain consists of pieces of mail, and the objective is to read the address on each piece. Thus the desired output in this case is a stream of alphanumeric characters.

Step1: 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 digitalize the signal produced by the sensor. The imaging sensor could also be a line-scan camera that produces a single image line at a time.

Step2: The next step deals with preprocessing that image. The key function of preprocessing is to improve the image in ways that increase the chances for success of the other process. Preprocessing typically deals with technique for enhancing contrast, removing noise, and isolating regions whose texture indicate a likelihood of alphanumeric information.

Step3: The next step deals with segmentation. Segmentation partitions an input image into its constituent parts or objects. In general autonomous segmentation is one of the most difficult tasks in digital image processing. On the one hand, a rugged segmentation procedure brings the process a long way toward successful solution of an imaging problem. On the other hand weak or erratic segmentation algorithms almost always guarantee eventual failure. In the terms of character recognition, the key role of segmentation is to extract individual characters and words from the background. The output of the raw pixel data, constituting either the boundary of a region or all the points in the region itself. In either case, converting the data to a form suitable for computer processing is necessary. The first decision that must be made is whether the data should be represented as a boundary or as complete region. Boundary representation is appropriate when the focus is on external shape characteristics, such as corners and inflections. Regional representation is appropriate is on internal properties, such as texture or skeletal shape. In some applications however, these representations coexist. This situation occurs in character recognition applications, which often require algorithms based on boundary shape as well as skeletons other internal properties.

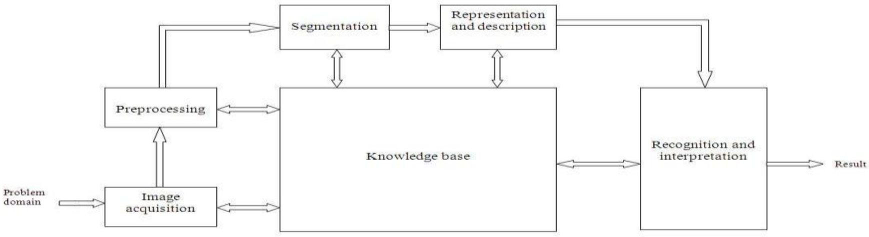


Fig : Fundamental Steps in Digital Image Processing [7]

Step4: Choosing a representation is only part of the solution for transforming raw data into a form suitable for subsequent computer processing. A method must also be specified for describing the data for features of interest are highlighted. *Description*, also called *feature selection*, deals with extracting features that result in some quantitative information of interest or features that are basic for differentiating one class of objects from another.
Step5: The last stage is recognition and interpretation. Recognition is the process that assigns a label to an object based on the information provided by its descriptors. Interpretations involve assigning meaning to an ensemble of recognized objects.

IV. IMAGE SEGMENTATION

Segmentation [4] refers to the process of partitioning a digital image into multiple region (set of pixels). Each of the pixels in a region are similar with respect to some characteristic such as color, intensity, texture. Adjacent regions are different with respect to the same.

1 Gradient operator

This is a part of image segmentation [4]. Through the gradient operator the edge can be detected and make it smooth.For estimating image gradients from the input image or a smoothed version of it, different gradient operators can be applied. The simplest approach is to use central differences:[4]

$$L_x(x,y) = -1/2 \cdot L(x-1,y) + 0 \cdot L(x,y) + 1/2 \cdot L(x+1,y).$$

$$L_y(x,y) = -1/2 \cdot L(x,y-1) + 0 \cdot L(x,y) + 1/2 \cdot L(x,y+1).$$

2 Edge Detection

There are many methods for edge detection, but most of them can be grouped into two categories, search-based and zero-crossing based. The search-based methods detect edges by first computing a measure of edge strength, usually a first-order derivative expression such as the gradient magnitude, and then searching for local directional maxima of the gradient magnitude using a computed estimate of the local orientation of the edge, usually the gradient direction. The zero-crossing based methods search for zero crossings in a second-order derivative expression computed from the image in order to find edges, usually the zero-crossings of the Laplacian or the zero crossings of a non-linear differential expression, as will be described in the section on differential edge detection following below. As a pre-processing step to edge detection, a smoothing stage, typically Gaussian smoothing, is almost always applied.The well-known and earlier Sobel operator is based on the following filters: [4]

$$L_x = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix} * L \quad \text{and} \quad L_y = \begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix} * L$$

Given such estimates of first- order derivatives, the gradient magnitude is thencomputed as:

$$|\nabla L| = \sqrt{L_x^2 + L_y^2}$$

While the gradient orientation can be estimated as

$$\theta = \text{atan2}(L_y, L_x)$$

3 Point Detection

The detection of isolated points in an image is straightforward. Using the mask shown in next Fig, we say that a point has been detected at the location on which the mask is centered if

$$R > T \quad \text{……………………} \ (1)$$

Where T is a nonnegative threshold and R is given by the equation below [7]

$$R = W_1Z_1 + W_2Z_2 + W_3Z_3 + \ldots + W_9Z_9$$

Where Z_i is the gray level of the pixel associated with mask coefficient W_i.Basically, all that this formulation does is measure the weighted differences between the center point and its neighbors. The idea is that the gray level of an isolated point will be quite different from the gray level of its neighbors.

4 Region–oriented segmentation

The objective of segmentation is to partition an image into regions. We approach this problem by finding boundaries between regions based on intensity discontinuities, whereas earlier segmentation was accomplished via thresholds based on the distribution of pixel properties, such as intensity or color. Here we discussed segmentation techniques that are based on finding the regions directly.

Basic formulation:

Let R represent the entire image region. We may view segmentation as a process that partitions R into n sub-regions, R_1, R_2 …R_n, such that

a. $\sum_{i=0}^{n} R_i = R$,

b. $R_i$is a connected region, i = 1,2,…….n,

c. $R_i \cap R_j = \emptyset$ for all i and j, $i \neq j$,

d. $P(R_i)$ = TRUE for i = 1,2,……….,n, and

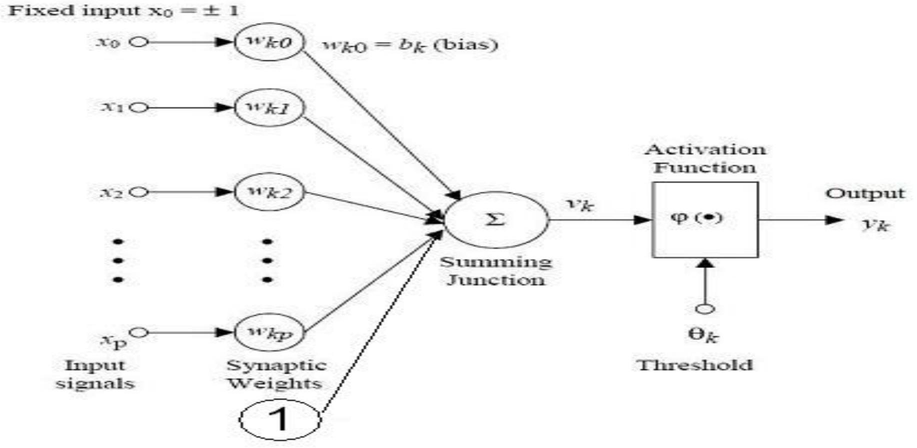
e. $P(R_i \cup R_j)$ = FALSE for $i \neq j$,

Where $P(R_i)$ is a logical predicate over the points in set $R_i$and $\emptyset$is the null set. Condition (a) indicates that the segmentation must be complete; that is, every pixel must be in a region. The second condition requires that points in a region must be connected. Condition (c) indicates that the regions must be disjoint. Condition (d) deals with the properties that must be satisfied by the by the pixels in a segmented region- for example $P(R_i)$ =TRUE if all pixels in R_i have the same intensity. Finally, condition (e) indicates that regions R_i and R_j are different in the sense of predicate P.

V. NEURAL NETWORK CONCEPT

Neural Network [2] which are simplified models of biological neuron system, is a massively parallel distributed processing system made up of highly interconnected neural computing elements that have the ability to learn and thereby acquire knowledge and make it available for use.The structural constituents of human brain termed neurons are entity which performs computation such as cognition, logical inference, pattern recognition and so on. Hence the technology, which has been built on a simplified imitation of computing by neuron of a brain, has been termed as Artificial Neural Network.A human brain develops with time; this common parlance is known as experience. Technically this involves the development of neuron to adapt to their surrounding environment by updating their weight factors.

1. BASIC MODEL OF ARTIFICIAL NEURAL NETWORK[8]



Here x1, x2, x3….xn are the input to artificial neuron.w1,w2,w3,w4…wn are the corresponding weights attached to the input links. One biased input has been considered having weight –k.
So the output can be calculated as bellow..

Vk=Wk1.X1+Wk2.X2+Wk3.X3-k

$$Vk = \sum_{i=1}^{n} Xi.Wki - k$$

Now the activation function wll be applied on it.

$$Vk' = f \sum_{i=1}^{n} Xi.Wki - k$$

Activation Transfer Function: This function represent the transfer characteristic of individual neuron.It determines the behavior of the incident inputs using dutiable learning algorithem.
Interconnection topology:This refers the mode of interconnection of the neuron in different layers of neural network.As in the biological neuron axon synopsis interconnection act as the storage junction similarly the interconnection if artificial neural network is characterized by weight factors which ascertain their activation level.
Learning Algorithem:There are two types of learning one is feedforward manner and another is feedback manner where a loop exist.In feedback algorithem information can be moved in backward direction or to the previous layers.

2.OPERATION MODES:

The operation modes of neural network can be classified into two main categories viz,supervisedans unsupervised learning.
Supervised learning: This architecture implies the use of some prior knowledge base to guide the learning phase. This knowledge base puts forward to the neural network a training set of input-output patterns and an input – output relationship. The neural network is then supervised to embed an approximation function in its operation.
Unsuprvised learning: This is an adaptive learning paradigm, which present the neural network with an input and allow it to self-organize the topological configuration depending on the distribution of the input data by means of prototype of input vector presented.

VI. RESULT

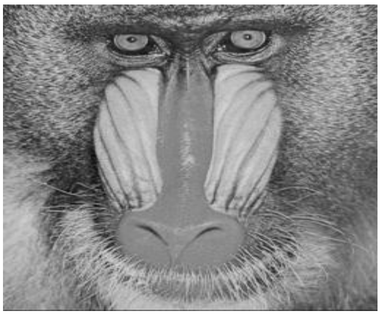
Gray Scale Image
Lena Image :-
Input Image :-

No.	Grey Scale Boundaries	Correlation
1.	{0, 21, 65, 106, 138, 167, 227, 255}	0.8970
2.	{0, 41, 80, 123, 158, 201, 240, 255}	0.8846
3.	{0, 38, 71, 113, 135, 168, 209, 255}	0.9068
4.	{0, 47, 80, 111, 146, 168, 212, 255}	0.9053
5.	{0, 47, 61, 111, 120, 169, 172, 255}	0.8605
6.	{0, 47, 53, 117, 119, 167, 172, 255}	0.7994
7.	{0, 48, 55, 121, 135, 185, 195, 255}	0.8051
8.	{0, 53, 55, 119, 121, 170, 186, 255}	0.7878

The output images are shown in the figure 6.4.1 and 6.4.2. figure 6.4.1 (a) represents the output image corresponding the set of serial no 1. Figure 6.4.1(b) represents the output image corresponding the set of serial

no 2 and so on. Similerly figure 6.4.2 (a) represents the output image corresponding the set of serial no 5 and figure 6.4.2 (b) represents the output image corresponding the set of serial no 1 and so on.
Baboon Image :-

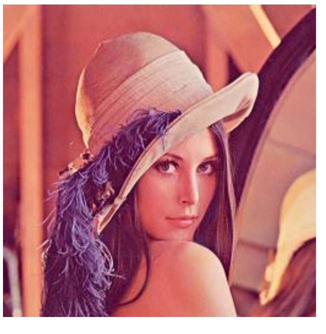
Input Image :-



No.	Grey Scale Boundaries	Correlation
1.	{0, 68, 91, 112, 141, 169, 190, 255}	0.7570
2.	{0, 66, 84, 116, 143, 166, 189, 255}	0.7537
3.	{0, 65, 104, 128, 152, 168, 191, 255}	0.7720
4.	{0, 40, 78, 114, 140, 164, 191, 255}	0.7543
5.	{0, 82, 90, 125, 133, 163, 169, 255}	0.6919
6.	{0, 81, 82, 124, 126, 159, 162, 255}	0.6464
7.	{0, 76, 82, 108, 114, 147, 150, 255}	0.6754
8.	{0, 85, 86, 125, 132, 164, 173, 255}	0.6673

The output images are shown in the figure 6.4.3 and 6.4.4. figure 6.4.3 (a) represents the output image corresponding the set of serial no 1. Figure 6.4.3(b) represents the output image corresponding the set of serial no 2 and so on. Similerly figure 6.4.4 (a) represents the output image corresponding the set of serial no 5 and figure 6.4.5 (b) represents the output image corresponding the set of serial no 1 and so on.

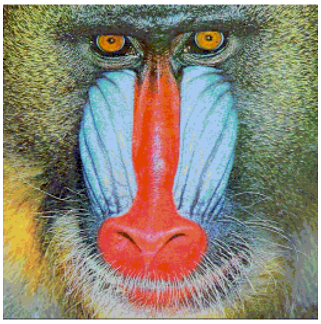
RGB Image:-
Lena Image:-
Input Image:



No	Bounderies	Correleation
1.	R={43, 89, 156, 160, 172, 213, 237, 255}	0.9052
	G={0, 34, 67, 110, 151, 155, 187, 255}	
	B ={32, 67, 91, 107, 126, 164, 186, 238}	
2.	R={43, 70, 120, 130, 150, 170, 190, 255	0.9035
	G={0, 20, 140, 180, 190, 210, 230, 255}	
	B ={32, 45, 77, 85, 115, 145, 175, 238}	
3.	R={43, 104, 129, 134, 155, 165, 183, 255}	0.9041
	G={0, 13, 57, 147, 160, 207, 221, 255}	
	B={32, 66, 89, 118, 143, 167, 190, 238}	
	R={43, 121, 129, 144, 196, 214, 233, 255}	

4.	G={0, 30, 51, 120, 134, 138, 204, 255}	0.9082
	B ={32, 65, 77, 101, 123, 154, 187, 238}	
5.	R={43, 80, 90, 110, 120, 190, 200, 255}	0.9111
	G={0, 30, 75, 80, 100, 160, 220, 255}	
	B ={32, 50, 70, 90, 110, 150, 170, 238}	
6.	R={43, 96, 109, 128, 141, 153, 206, 255}	0.9055
	G={0, 51, 61, 116, 141, 176, 186, 255}	
	B={32, 70, 81, 94, 120, 153, 181, 238}	
7.	R={43, 70, 108, 116, 126, 151, 165, 255}	0.9046
	G={0, 41, 111, 157, 166, 180, 200, 255}	
	B={32, 53, 74, 88, 128, 145, 162, 238}	
8.	R={43, 58, 72, 140, 172, 210, 232, 255}	0.8947
	G={0, 15, 48, 110, 142, 178, 220, 255}	
	B={32, 55, 87, 112, 136, 140, 215, 238}	

The output images are shown in the figure 6.4.5 and 6.4.6. figure 6.4.5 (a) represents the output imagecorresponding the set of serial no 1. Figure 6.4.5(b) represents the output image corresponding the set of serial no 2 and so on. Similerly figure 6.4.6 (a) represents the output image corresponding the set of serial no 5 and figure 6.4.6 (b) represents the output image corresponding the set of serial no 1 and so on.
Baboon Image:-
Input Image:-



No	Bounderies	Correlation
1.	R={0, 17, 52, 73, 83, 116, 204, 255}	0.8579
	G={0, 27, 102, 152, 153, 180, 254, 255}	
	B ={0, 48, 89, 117, 136, 177, 230, 255}	
2.	R={0, 82, 85, 159, 163, 210, 214, 255}	0.8541
	G={0, 84, 96, 114, 163, 194, 207, 255}	
	B={0, 30, 69, 100, 124, 153, 211, 255}	
3.	R={0, 94, 106, 146, 173, 186, 203, 255}	0.8481
	G={0, 39, 69, 74, 88, 111, 147, 255}	
	B={0, 52, 75, 90, 127, 162, 219, 255}	
4.	R={0, 50, 60, 90, 100, 110, 150, 255}	0.8044
	G={0, 60, 110, 160, 170, 185, 200, 255}	
	B ={0, 10, 20, 60, 80, 150, 220, 255}	
5.	R={0, 57, 59, 79, 100, 244, 251, 255}	0.7875
	G={0, 15, 41, 108, 169, 178, 196, 255}	
	B={0, 47, 51, 111, 115, 221, 233, 255}	
6.	R={0, 91, 106, 125, 142, 143, 170, 255}	0.8631
	G={0, 52, 54, 75, 83, 86, 167, 255}	
	B={0, 52, 70,90, 126, 160, 223, 255}	
7.	R={0, 45, 55, 75, 95, 225, 245, 255}	0.7897
	G={0, 10, 35, 95, 155, 175, 195, 255}	
	B={0, 35, 45, 105, 110, 215, 230, 255}	
	R={0, 78, 110, 134, 186, 210, 233, 255}	

8.	G={0, 42, 68, 92, 120, 162, 240, 255}	0.8715
	B={0, 65, 114, 148, 167, 195, 230, 255}	

The output images are shown in the figure 6.4.7 and 6.4.8. figure 6.4.7 (a) represents the output image corresponding the set of serial no 1. Figure 6.4.7(b) represents the output image corresponding the set of serial no 2 and so on. Similerly figure 6.4.8 (a) represents the output image corresponding the set of serial no 5 and figure 6.4.8 (b) represents the output image corresponding the set of serial no 1 and so on.

Figure 6.4.1: Out put of gray Lena Images (1)

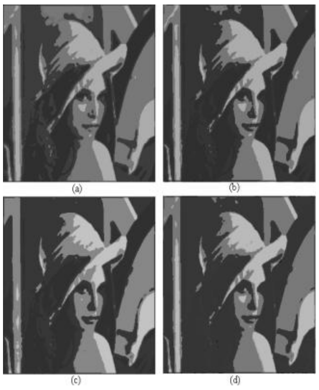


Figure 6.4.2: Out put of gray Lena Images (2)

Figure 6.4.5: Out put of color Lena Images (1)

Figure 6.4.6: Out put of color Lena Images (2)

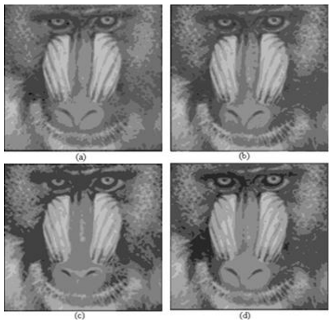


Figure 6.4.3: Out put of gray baboon Images (1)

Figure 6.4.4: Out put of gray Baboon Images (2)

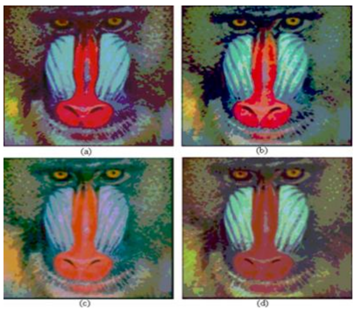


Figure 6.4.6: Out put of color Baboon Images (1)

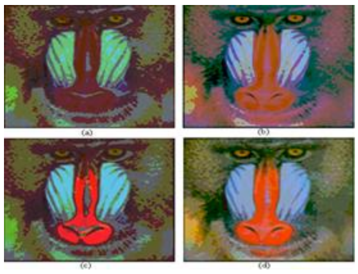


Figure 6.4.6: Out put of color Baboon Images (2)

VII. CONCLUSION

The neural network has not been used for the first time to segment an image. Previously image segmentation has been done using the MLSONN architecture. Many other algorithms are there for this purpose. The MLSONN architecture has some draw backs. As in this architecture in the back propagation part there is a recurrent loop connecting the output layer to the input layer which basically increase the complexity. This project work has been done based on the research that find the new BDSONN architecture in which the output is feed backed to hidden layer instead of input layer. It reduces so many computation burdens as much possible. That is the main advantage of this architecture that has been implemented in this project using the language Visual Basic 6.In the coming future BDSONN architecture will be widely used to perform image segmentation in the world. So the goal of our project is to put a look on this research and try to visualize our thought in this concern and this resource should be helpful.

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