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# Reducing of Colors in Digital Images by Using (Kohonen) Artificial Neural Networks

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## Abstract

***The colored digital images occupy an extensive area of the infigureation used in computer technology, and the most important property of the images is the color. By the help of the modern technology, we can get images consist of more than (16) million different colors; this number of colors, made image occupies a large area of storage. Color reduction is a very useful tool for segmentation, compression presentation and transmission of the image through the communication network. Also in most cases, it is easier to process and understand an image with a limited number of colors. This research uses a method based on self-organizing feature maps (SOFM) neural network. The (SOFM) is competitively trained according to the Kohonen learning algorithm. After training, the output neurons of the (SOFM) define proper classes of colors that best define the image by using Manhattan distance instead of the traditional Euclidean distance. Next each pixel is compared with resulted colors, and then each pixel is redrawn according the new colors. Also an enhancement operation has been made on the resulted image, to hide the some side affects resulted of the color reduction operation. In order to reduce the size of the image a transformation was made from (True Type) to (8 Bit), the program was written using (Visual Basic-6) programming language, and the research was applied on Colored and Gray level images.***

**Keywords:** Artificial Neural Network (ANN), Reduction colors, gray scale, level images.

## 1. Introduction

At the end of last century global has large scientific development in different fields, communications, multiple mediums and especially computer industries. Every day global industry companies surprised as in its productions especially in display industry field as a screen to computer or game devices which be active with users or TV or mobile which can display image to talking person and other modern techniques. We observe that most techniques depend on images and how to display them in best way and increase colors in it to seem as real image for its accurate [1]. Artificial Neural Network (ANN) is an information processing system that certain performance characteristics in common with biological neural network one of the main advantages of the ANN is that they infer solutions from data without prior knowledge of the regularities in the data; they extract the regularities empirically [2]. But this huge development in dealing with images and increasing its accurate lead to increase images size which lead to extra time for operation to treat images or transmit it through communication medium especially internet. There are many fields which need to reduce image size especially in games because it need to large space on CD also speed as an important requirement [3]. Reduction colors techniques became important in many applications especially in compressing, coding images, hiding information and showing images in documents base which have large images photographing by light survey [4]. Also we can use it in medical fields and treatment to satellites images that need to show images in limit colors. This research aims to reduce colors in images which have gray scale to ease images treatment operation also reduction to image size to storage large space on save mediums by reduction document sizes which lead to increase speed to transmit documents that have images through communication networks such as internet [5].

## 2. Reduce Colors in Gray Scale Images

In order to improve desirable feature vector properties, such as vector similarity within a given class, the images are scaled to remove size variation. The input character image (i, j), has 32 rows and 24 columns where I and j are the row and column numbers. Each pixel is binary-valued, with (0) representing white background and (1) representing part of the printed character. The smallest rectangular sub-image is found which contains black pixels. In gray scale we use three main classifications to reduce images colors [6]

**1-** Segmenting the image into the relevant objects and background parts is a crucial step in almost all image analysis tasks. It is also in many cases one of the more difficult task.
**2-** Ways depend on histograms which build on multithreshold choosing technique which choosingaccording to different standards such as choosing minimum value or chose entropy or by classifying interclass variance and others. The figure (1) shows the way to reduce image colors has gray scale (multihreshold).
**3-** Another don't related to previous classifications called hybrid such as using neural networks.

## 3. Kohonen Neural Network

### 3-1 Identification to Neural Kohonen Networks

The name of network related to who designed from Kohonen and called it self organized map, the first field used in it was o recognize audio and transfigure it to text[6]. Kohonen network different from many other networks such as the network of inverse extension. The training for this network don't need to activity as in another artificial networks and the update to its weighs different from another net works and output doesn't represent all cells values but just value to one cell which called (Winning cell), so that this network be competitive because the cells locate in output layer compete between each other to get final output and winning cells which result from training represent groups interred to network by that kohonen network called self- organize network for it is an operation to arrange part of system in such way without impose anything on this organize,so that, called it subjective arrangement system[7].

### 3-2 General Architecture to Neural Kohonen Network

Neural networks are recently being applied on variouskinds of pattern recognition processing, such ascharacterrecognition, speech recognition, and object recognition [8].The Neural Kohonen network or self – organizedcontains two layers; input layer and output layer which called competitive layer , each cell in input layer connect to cell from output layer and documents extension from input layer to output layer in a head feed back and there is no calculation in input layer[8]. Competitive layer contains one dimension( unilateral matrix ), for each cell there are two close cells as in figure(2), or two dimension (binary matrix), there are (8) close cells to each cell as in figure (3), it is possible to matrix to be hexagon and by that will have (6) cells. The area that has close cells with the wining cell called window and close cells number be more at start training and be less gradually during time where cells number at time( Nc (t2)) be large and then less at time (Nc(t3)) and so on till we arrive to winning cell (C).

### 3-3 Kohonen Network Training Algorithm

Kohonen network follows competitive learning where layer cell competitive between each other to get network output or called demand (activity level) and weighs modification will do only on winning and close cell, there are two styles to account activity level as following:

1- Account level activity which depends on output calculation to each cell from output layer and consider cell that has high value to output the winner neuron, fixed one value to it and another cells zero value.

$$NETj = Wij * Xi \quad (1)$$

(NETj) : competitive layer (j) Cell output signal
(W ij) : interred to network (Xi) represents weigh connect to value.

2- Account output to network depends on account distance between input and output cells, more used equation is distance equation which is square root to square result mines weighs from input. From beginning account distance and consider cell in output layer which has less distance the winner cell [9].

$$^{yi} = \sum\sqrt{(xj-wij)}\text{Distance} \quad (2)$$

To train neural kohonen network we need to prepare weighs matrix which may be unilateral or binary according to the application also need to prepare documents that inter to the network but before interring documents to network we should do normalization on documents and transfigure input matrix value to value about ( 0.1) also weighs matrix value which be about (0.1) . The weighs matrix will in following form:

$$W(mn) = \begin{pmatrix} W11 & W12 & W13 & W1n \\ W21 & W22 & W23 & W2n \\ Wm1 & Wm2 & Wm3 & Wmn \end{pmatrix}$$

General Kohonen algorithm (self-learning) will be from following steps:

1- Prepare initial value to learning coefficient and number of initial close cells and term long tochange learning coefficient and frequently number or choose assumption distance to arrive solution.
2- Prepare weighs matrix in small arbitrary values, matrix dimensions (m*n).
m: represents cells number in competitive layer.
n: represents elements number formed input direction .
3- Each input direction (X (I)) will account active level according to choosing active equations then choose winner cell which has high active level.

4- Update weighs matrix to winner cell and close cell according to following equation:
Wij (New) = Wij (Old) + alpha (I)* ((Xi)-Wij(Old))
Wij (New) Means new weight
Wij (Old) Means old weight
Means learning coefficient alpha (I)
Means input direction (Xi)
5- Choose stop condition which represents in frequencies and network stable to arrive assumption distance

## 4. Research Procedure

Work had computerized by using object oriented programming because the new of this style and it gives flexibility to work and consider that any computerized part independent and can call it in any time. Computerized part to neural kohonen network had put in class and alone to recognize it from other parts of the program also ease update operations in the future. The program had written in visual basic language because it offers facilities in deal field with image and colors. It had used some applications programming interface (API) instead of tradition recommends in reading images to ease to increase reading and printing speedimages because it takes more time tradition recommends. For the (API) functions locate with dynamic link library which related to (Windows), when execute program these function will call directly from the main memory and became ready to execute and there no need to connect functions with other programs as we used to do in tradition ways.

### 4.1 Programmed Connection Applications Functions (API)

It had used two function of(API win32) to read and printing pixel to images these functions are:
**1- Function to read pixel (Get pixel)**. To use this function we should put this identification in program beginning:
Public Declare Function Get Pixel Lib "gdi32" (ByValhdc as Long,
By Val x as Long, By Val y as Long) As Long
- **(hdc)** represents image name connection that need to read in this variable, so it means to get image name attach title (hdc), it is abbreviation ( Handle Device Context ).
- **(x, y)** represents axes or pixel and put the result in variable represents color to this light unit.
2- Light unit printing function (SetpixelV), to use this function it should put the following identification in program beginning:
Public Declare Function SetPixelV Lib "gdi32" (ByVal hdc As Long, ByVal x As Long, ByVal y As Long, ByVal crColor As Long) As Long
- **(hdc)** represents image name connection that need to read in this variable, so it means to get image name attach title (hdc).
- **(x,y)** represents axes or pixel and put the result in variable represents color to this light unit.
- **(Color):** Represents pixel value.

### 4.2 Self Organized Network

The structure for the neural network used in these experiments was that for a three layered feed forward neural network. The first layer is an input layer, the second layer is a hidden layer, and the top layer is an output layer. Each layer includes several units, each of which works as an artificial neuron cell, figure (4) show the structure of neural network, to reduce colors and we still need to choose best colors which representimage. Each color had choosed is a classification then will repeat paint image and compare origin image elements with classification that produced from training operation and appoint each color to close classification.

### 4.3 Description to Used Algorithm

The following is the description to the way using weighs matrix and input direction to training operation:
1- **Form weighs matrix**: Weigh matrix will generate in arbitrary way which value to each weigh be about (1-255) to be fit with image light unit where value to each unit (Pixel) be about (1-255), figure (5) show the matrix size be at same demand color numbers. Columns number in this matrix equal three , each column bears elementbasic value to light unit R(I,J), G(I,J), B(I,j) , matrix size be at same demand color numbers multiply in three , matrix form as following :

## 5. Result and Dissection

Contains by dividing each light unit in to its three main parts (R, G, B) and each part value be about (1-256), It had choose Manhattan equation instead of tradition equation so that to reduce account operations and this equation gave good result compared to distance equation and the different in result image from use two equation.
DI= (|R-Ri| +|G-Gi| +|B-Bi|) Manhattan equation
Main contains to light unit: (R, G, B)

To reduce image colors it should inter demand colors number to final image and doing network training to get idealistic weighs which represents image according to distribute colors in image and after finished training and fixed final weighs matrix then 8painting image according the colors that resulted from training(4=u74) by using Manhattan equation and compare each pixel in origin image with resulted weighs matrix, change light unit colors in origin image in new colors value, then apply work on image has gray scale type(256) color, results were good where inter to the network basic three elements to each light unit, in this case the three values will be equal because it doesn't have color , output result will be one value to the three elements. Figure(5) describes reduction image colors operation has gray scale to only seven colors and table (1) shows the weighs that resulted from training operation.
Connected weighs to main contain of: (Ri, Gi, Bi)
light unit

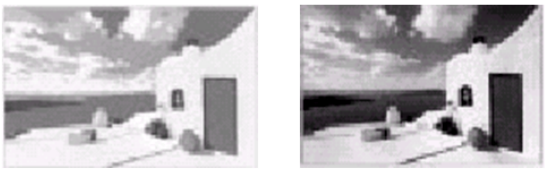
**Table (1)** Resulted Weighs from reduction colors operation to image has gray scale

| GRAY |
|---|
| 217 |
| 161 |
| 114 |
| 81 |
| 54 |
| 33 |
| 6 |

After getting new image resulted from colors reduction operation which is from type (True Type ), (24bit), or (32bit), will keep weighs matrix resulted from color reduction operation , to transfigure image to(8bit) it will figure colors elements(Pallet ) and should fix(256) colors to fill colors board by that document size will change to new size may arrive to quarter origin file size.

## 6. Conclusions

During apply neural Kohonen network to reduce image colors has gray scale we conclude the following:
1- It is observed that the image which has gray scale and contains little colors can be reduced its colors to limit (4 colors) without clear defect.
2- After colors reduction on gray scale image it can keep its true type for more application doesn't care to image size compared its care to image information.
3- It can change resulted image to file type ( 8bit) to reduce its size without any defect in transfigure operation and reduce image size will reduce time to transform it through internet.



(a) (b)

**Figure (1)** Gray scale image colors reduction (a) changing image to (11) colors (b) true type

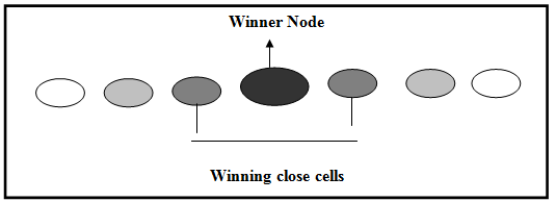



**Figure (2)** describe unilateral competitive layer and winner cell with two closed [3]

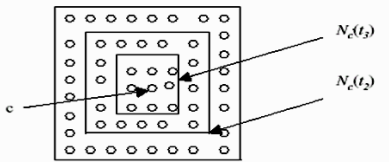



**Figure (3)** Shows Bilateral dimensions competitive layer [2]

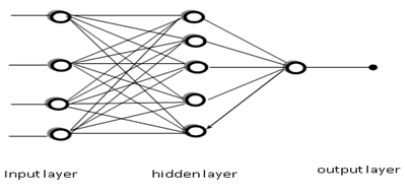



**Figure (4)** the structure of neural network [5]

$$W(N,3)\begin{pmatrix} R & G & B \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot \\ Ri,1 & Gi,2 & Bi,3 \end{pmatrix}$$

**Figure (5)** Shows matrix size be at same demand color numbers [3]


Figure(6) Describe image has gray scale before and after reduction colors
(a)Resulted Image contain(10), (b) Colors True Image [9]

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