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Building Face Recognition System (FRS)

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Abstract: Face recognition system is a vital system, which is now used in many important applications such security systems, banking systems, robotics application, police applications and so on. Deferent approached were discussed and used to build FRS, here in our research paper we will introduce a simple and accurate procedures, which can be easily used in any digital signal recognition systems. The procedures will contain a simple sequence of task which can be easily implemented by any available programming language, here in our research paper we will focus on matlab, the procedure tasks will be implemented and the obtained experimental results will be discussed to do some recommendations.

Keywords: color image, features vector, ANN, MLBP, extraction time, training time, running time.

Introduction

Digital signals [1], [2] such voice signals [3], [4] and digital color images [5], [6], [7] are very important type of data because they are using in any vital applications such security systems and computer classification systems [4], [5]. Here in this paper we will introduce a procedure to build a human face recognition system (FRS) [6], [7].

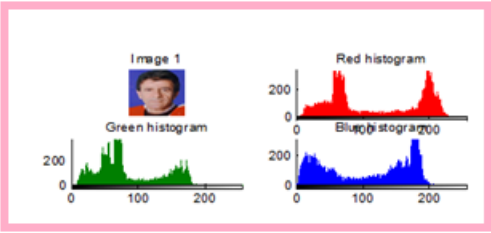

Figure 1: Color image and histogram

Digital color image as shown in figure 1 is represented by 3D matrix, the first dimension represents the red color, the second represents the green color, while the third one represents the blue color, and mixing these three colors together gives the pixel color time [1], [8],[9] .

Digital signals [10], [11], [12] including digital color images usually have huge size, which makes the process of matching the image pixel by pixel inefficient because here the process of matching requires a big time [3], [4]. Color image can be represented by a histogram [10], [12],

[13],[14] , one for each color, here we can decrease the number of element to 256 values for each histogram[12], [13],[14], also we can gather the three histograms in one, but we still have a big number of elements to be treated in the matching process [5], [6], [9]. To reduce the classification (recognition) time we have to use signal features instead of using the signal [13], the features vector for each color image will be unique, simple, fixed and will contain a small number of values [14], [15], [16].

Proposed procedure to build FRS

FRS usually contains image database(a folder of selected images), features database (2 dimensional matrix with number of rows equal the number of features, and number of columns equal the number of each images(one column for each image)) and the recognition tool, the process of image classification is shown in figure 2 :

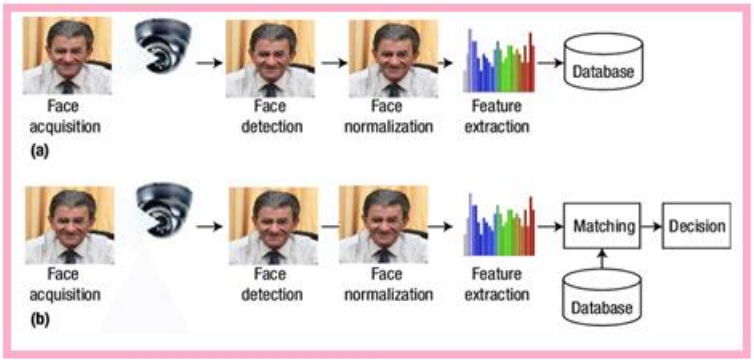

Figure 2: Feature extraction and classification

The classification process can be implemented also by using the extracted known features as shown in figure 3:

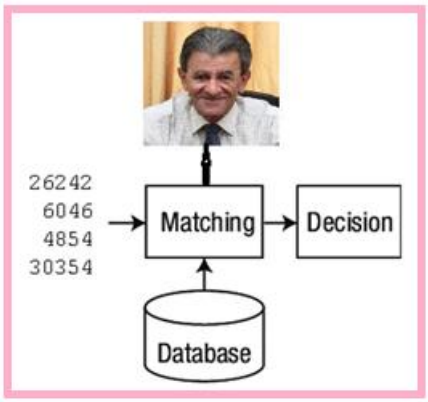

Figure 3: Classification using the known features

To build FRS we have to implement the following steps in sequence:

Step 1: Building a features database

Deferent methods were used to create a digital signal features, some of these methods use linear prediction coding (LPC) [17], other methods use the clustering principles based on k_mean [18], [19] and fuzzy clustering [20], [21], other methods use finite impulse response filter (FIR) coefficients to create signal features [22], [23], other use wavelet packet tree (WPT) decomposition [24], [25]. These methods create unique features for each speech signal but they require high features extraction time.

In our research paper we will introduce a modified method based on local binary pattern (LBP) method [26], [27], [28], [29], and we will refer to it as modified LBP (MLBP).

MLBP features can be extracted performing the following tasks:

a- Get the color image.

b- Reshape the color image from 3D matrix to one row matrix.

c- Initialize the features vector to zeros (4 elements vector).

d- For each pixel in the reshaped color image apply the step shown in table 1:

Table 1: MLBP operator calculation (for each pixel) calculation

pixel	....	p(i-2)	p(i-1)	p(i)	p(i-1)	p(i-2)	.....
Gray Values	...	100	241	0	200	203	...
		<=	<=				
Binary		1	0				
Decimal		2					
So add 1 to the vector with index=2							

So this step can be summarized in the following actions:

1- Select the color image from the image database (folder).

2- For each color image create the features vector.

3- Add features vector as one column to features matrix (features data base).

4- When ending save the features database(FDB) to be used later in the recognition process

STEP 2: Creating and training ANN

Artificial neural network is a power full computational tool [30], [31], it contains a set of fully connected neurons [32],[33] arrange in one or more layers as shown in figure 4 [34], [35], here in our research paper we will use Feedforward ANN, here each training cycle as shown in

figure 4 takes 2 operations a forward operation to calculate the output of each neuron and a backward operation if the error is not acceptable to adjust ANN weights.

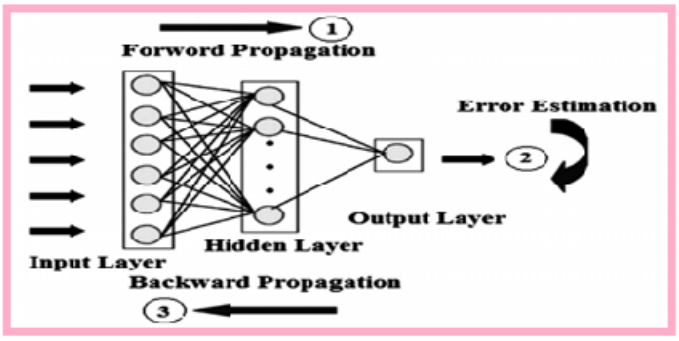

Figure 4: ANN with 3 layers

Each neuron acts as a computational element as shown in figure 5 [36], [37] and performs summation and output calculation according the activation function selected for this neuron, some of these functions are shown in figure 6.

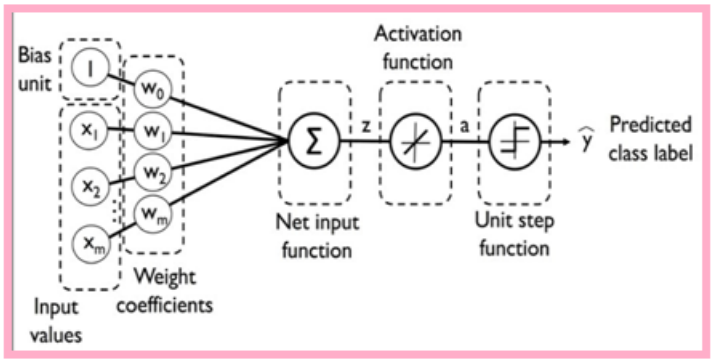

Figure 5: Neuron operations

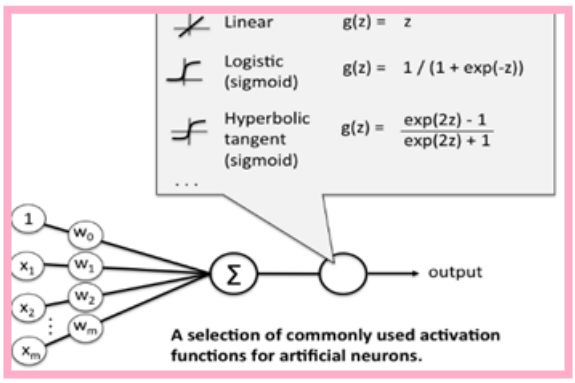

Figure 6: Some used activation functions

This step can be implemented applying the following actions:

1- Select FDB as ANN input

2- Define the targets, which are a numbers used as classifiers for the color images.

3- Creating ANN: here we have to select at least 2 layers: input layer with 4 neurons and output layer with I neuron, the activation function for the input layer must tansig or logsig, for the output layer it must be linear.

4- Initialize all the weights to zero.

5- Set the goal (error) to zero.

6- Select a number of training cycles (we use 500);

7- Train ANN using the inputs and the targets.

8- Check the outputs, if they are not acceptable adjust ANN architecture and train again.

9- If the outputs are acceptable save ANN to be used later.

Step 3: Running ANN as a classifier

In this final step we have use ANN as a classification tool by doing the following (for each run):

1- Get the color image features, by reading the image and applying the same method used for features extraction.

2- Load ANN

3- Get the classifier by running ANN with the extracted features.

4- Do any action according to the classifier value,

Also we can directly use the features (if they are known) by interring them, and using them to feed ANN.

Implementation and experimental results

1- Features extraction

The color images shown in figure 7 were treated using MLBP method; table 2 shows the obtained results:

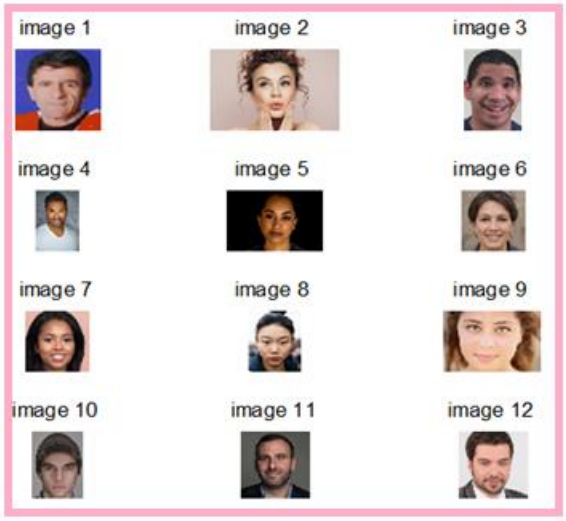

Figure 7: Used face color images

Table 2 shows the extracted features

Table 2: Obtained face images features

Image #	Features				Extraction time(sec.)
1	26242	6046	4854	30354	0.0030
2	21177	8040	3886	37393	0.0020
3	50924	11186	9607	79254	0.0060
4	55780	13154	7076	74961	0.0060
5	18628	6254	4280	121809	0.0090
6	18293	3928	3076	21574	0.0030
7	53703	12482	7589	78097	0.0070
8	63581	11862	6691	69215	0.0080
9	56930	11870	8019	74152	0.0060
10	42537	11367	8079	89528	0.0060
11	35154	11646	6239	98832	0.0120
12	41597	11877	7699	90698	0.0080
		Average			0.0063

From table 2 we can see that the features vector for each color face is unique, the extraction process requires a significant small time (average=0.0063seconds), this task is to implemented one time and if we 1000000 faces, then this task will require 6300 seconds (1.7500 hours), which is significantly small time. After finishing this step we will get features database which looks like figure 8.

```
features =

  Columns 1 through 7

      26242      21177      50924      55780      18628      18293      53703
       6046       8040      11186      13154       6254       3928      12482
       4854       3886       9607       7076       4280       3076       7589
      30354      37393      79254      74961     121809      21574      78097

  Columns 8 through 12

      63581      56930      42537      35154      41597
      11862      11870      11367      11646      11877
       6691       8019       8079       6239       7699
      69215      74152      89528      98832      90698
```

Figure 8: Features database

Figure 9 shows the used matlab code:

```
close all,
c = imread('face12.jpg');
[n1 n2 n3]=size(c);
ss=n1*n2*n3;
a=reshape(c,1,n1*n2*n3);
tic
f=zeros(4,1);
for i=3:ss-2
            ind=(a(1,i-1)<=a(1,i+1))+2*(a(1,i-2)<=a(1,i+2));
            f(ind+1,1)=f(ind+1,1)+1;
end
extractiontime=toc
f
features(:,12)=f
```

Figure 9: Features extraction code

2- ANN creation and training

ANN was created using the procedures mentioned above; figure 10 shows the used matlab code:

```
clear all,clc,close all
tic
load features
in=features/100000;
tar=[1,2,3,4,5,6,7,8,9,10,11,12];
imagenet=newff(minmax(in),[4 1],{'tansig','purelin'});
imagenet=init(imagenet);
imagenet.trainParam.goal=0;
imagenet.trainParam.epochs=1000;
imagenet=train(imagenet,in,tar);
sim(imagenet,in)
save imagenet.mat
toc
```

Figure 10: Training code

The training process required 0.992000 seconds (127 cycles), and this process will be implemented one time, except if add an extra face image, if so the whole process must be repeated, the created ANN classifier required 26653 byte memory space.

3- ANN running

The generated ANN was executed once for each face image color, the recognition ratio was equal 100 %(each time of processing the calculated classifier was correct), the execution process requires a significant small time (in average 0.0597 seconds) .

The recognition process was implemented in 2 ways:

- Using a face image, here we have to extract a features for this image, then we the extracted features as an inputs of the executed ANN, figure 11 shows the used code, and figure 12 shows a sample output:


```
c = imread('face8.jpg');
%get the image features
[n1 n2 n3]=size(c);
ss=n1*n2*n3;
a=reshape(c,1,n1*n2*n3,1);
feat=zeros(4,1);
for i=3:ss-2


            ind=(a(1,i-1)<=a(1,i+1))+2*(a(1,i-2)<=a(1,i+2));
            feat(ind+1,1)=feat(ind+1,1)+1;
end
feat
load imagenet;

clas=round(sim(imagenet,feat/100000))
```

Figure 11: Way 1 of recognition code

```
feat =

       63581
       11862
        6691
       69215


clas =

     8
```

Figure 12: Sample output (way 1)

- The second way is to directly use the features if they are known, figure 13 shows the used code, while figure 14 shows a sample output:

```
clear all
clc
close all
load imagenet;
for i=1:4
    k=input('type feature:');
    feat(i,1)=k;
end
clas=round(sim(imagenet,feat/100000))
```

Figure 13: Way 2 of recognition code

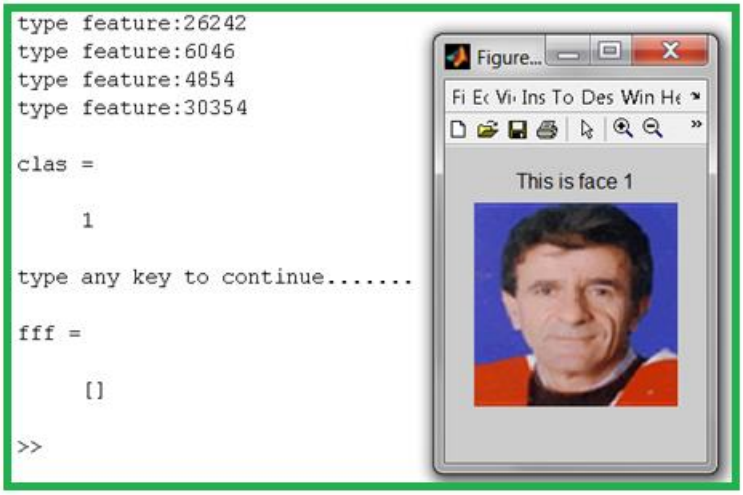

Figure 14: Sample output (way 2)

Conclusion

FRS creation procedure was proposed, the procedure is consisted of a sequence of simple steps, these steps were implemented and tested and the obtained experimental results showed that the extracted features were stable and fixed, the propose procedure has a good advantages such as required times for features extraction, ANN training, and ANN running are significantly small, the required memory space used to store the features and ANN is also very small in size.

References

[1] Ziad Alqadi, Bilal Zahran, Jihad Nader, Estimation and Tuning of FIR Lowpass Digital Filter Parameters, International Journal of Advanced Research in Computer Science and Software Engineering, vol. 7, issue 2, pp. 18-23, 2017.
[2] Haitham Alasha'ary, Abdullah Al-Hasanat, Khaled Matrouk, Ziad Al-Qadi, Hasan Al-Shalabi, A Novel Digital Filter for Enhancing Dark Gray Images, European Journal of Scientific Research , pp. 99-106, 2014.
[3] Majed O Al-Dwairi, Ziad A Alqadi, Amjad A Abujazar, Rushdi Abu Zneit, Optimized true-color image processing, World Applied Sciences Journal, vol. 8, issue 10, pp. 1175-1182, 2010.
[4] Jamil Al Azzeh, Hussein Alhatamleh, Ziad A Alqadi, Mohammad Khalil Abuzalata, Creating a Color Map to be used to Convert a Gray Image to Color Image, International Journal of Computer Applications, vol. 153, issue 2, pp. 31-34, 2016.
[5] Musbah J. Aqel, Ziad A. Alqadi, Ibraheim M. El Emary, Analysis of Stream Cipher Security Algorithm, Journal of Information and Computing Science, vol. 2, issue 4, pp. 288-298, 2007.
[6] Jamil Al-Azzeh, Ziad Alqadi, Mohammed Abuzalata, Performance Analysis of Artificial Neural Networks used for Color Image Recognition and Retrieving, International Journal of Computer Science and Mobile Computing, vol. 8, issue 2, pp. 20 – 33, 2019.
[7] Akram A. Moustafa and Ziad A. Alqadi, Color Image Reconstruction Using A New R'G'I Model, Journal of Computer Science, vol. 5, issue 4, pp. 250-254, 2009.
[8] Dr. Ziad Alqadi, Akram Mustafa, Majed Alduari, Rushdi Abu Zneit, True color image enhancement using morphological operations, International review on computer and software, vol. 4, issue 5, pp. 557-562, 2009.
[9] Mohammed Ashraf Al Zudool, Saleh Khawatreh, Ziad A. Alqadi, Efficient Methods used to Extract Color Image Features, IJCSMC, vol. 6, issue 12, pp. 7-14, 2017.
[10] Ayman Al-Rawashdeh, Ziad Al-Qadi, Using wave equation to extract digital signal features, Engineering, Technology & Applied Science Research, vol. 8, issue 4, pp. 1356-1359, 2018.
[11] AlQaisi Aws, AlTarawneh Mokhled, A Alqadi Ziad, A Sharadqah Ahmad, Analysis of Color Image Features Extraction using Texture Methods, TELKOMNIKA, vol. 17, issue 3, 2018.
[12] Dr Ziad A AlQadi, Hussein M Elsayyed, Window Averaging Method to Create a Feature Victor for RGB Color Image, International Journal of Computer Science and Mobile Computing, vol. 6, issue 2, pp. 60-66, 2017.
[13] Dr. Ghazi. M. Qaryouti, Prof. Ziad A.A. Alqadi, Prof. Mohammed K. Abu Zalata, A Novel Method for Color Image Recognition, IJCSMC, Vol. 5, Issue. 11, pp.57 – 64, 2016.

[14] Jihad Nader Ismail Shayeb, Ziad Alqadi, Analysis of digital voice features extraction methods, International Journal of Educational Research and Development, vol 4, issue 1, pp. 49-55, 2019.
[15] Ahmad Sharadqh Naseem Asad, Ismail Shayeb, Qazem Jaber, Belal Ayyoub, Ziad Alqadi, Creating a Stable and Fixed Features Array for Digital Color Image, IJCSMC, vol. 8, issue 8, pp. 50-56, 2019.
[16] Majed O. Al-Dwairi, Amjad Y. Hendi, Mohamed S. Soliman, Ziad A.A. Alqadi, A new method for voice signal features creation, International Journal of Electrical and Computer Engineering (IJECE), vol. 9, issue 5, pp. 4092-4098, 2019.
[17] Dr. Amjad Hindi Dr. Majed Omar Dwairi Prof. Ziad Alqadi, PROCEDURES FOR SPEECH RECOGNITION USING LPC AND ANN, International Journal of Engineering Technology Research & Management, vol. 4, issue 2, pp. 48-55, 2020.
[18] Yousf Eltous Ziad A. AlQadi, Ghazi M. Qaryouti, Mohammad Abuzalata, ANALYSIS OF DIGITAL SIGNAL FEATURES EXTRACTION BASED ON KMEANS CLUSTERING, International Journal of Engineering Technology Research & Management, vol. 4, issue 1, pp. 66-75, 2020.
[19] Prof. Yousif Eltous, Dr. Ghazi M. Qaryouti, Prof. Mohammad Abuzalata, Prof. Ziad Alqadi, Evaluation of Fuzzy and C_mean Clustering Methods used to Generate Voiceprint, IJCSMC, vol. 9, issue 1, pp. 75 -83, 2020.
[20] Ahmad Sharadqh Naseem Asad, Ismail Shayeb, Qazem Jaber, Belal Ayyoub, Ziad Alqadi, Creating a Stable and Fixed Features Array for Digital Color Image, IJCSMC, vol. 8, issue 8, pp. 50-56, 2019.
[21] Ahmad Sharadqh Jamil Al-Azzeh, Rashad Rasras , Ziad Alqadi , Belal Ayyoub, Adaptation of matlab K-means clustering function to create Color Image Features, International Journal of Research in Advanced Engineering and Technology, vol. 5, issue 2, pp. 10-18, 2019.
[22] Dr. Amjad Hindi Prof. Yousif Eltous Prof. Mohammad Abuzalata Prof. Ziad Alqadi Dr. Ghazi M. Qaryouti, USING FIR FILTER COEFFICIENTS TO CREATE COLOR IMAGE FEATURES, International Journal of Engineering Technology Research & Management, vol. 4, issue 2, pp. 6-14, 2020.
[23] Prof. Yousif Eltous Dr. Amjad Hindi, Prof. Ziad Alqadi, Dr. Ghazi M. Qaryouti, Prof. Mohammad Abuzalata, Using FIR Coefficients to Form a Voiceprint, International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering, vol. 8, issue 1, pp. 1-6, 2020.
[24] Dr. Ghazi M. Qaryouti, Prof. Mohammad Abuzalata, Prof. Yousf Eltous, Prof. Ziad Alqadi, Comparative Study of Voice Signal Features Extraction Methods, *IOSR* Journal of Computer Engineering (IOSR-JCE), vol. 22, issue 1, pp. 58-66, 2020.
[34] Amjad Y. Hindi, Majed O. Dwairi, Ziad A. AlQadi, Analysis of Digital Signals using Wavelet Packet Tree, IJCSMC, vol. 9, issue 2, pp. 96-103, 2020.
[25] Amjad Y. Hindi, Majed O. Dwairi, Ziad A. AlQadi, Creating Human Speech Identifier using WPT, International Journal of Computer Science and Mobile Computing, vol. 9, issue 2, pp. 117 – 123, 2020.
[26] Ismail Shayeb, Ziad Alqadi, Jihad Nader, Analysis of digital voice features extraction methods, International Journal of Educational Research and Development, vol. 1, issue 4, pp. 49-55, 2019.
[27] Aws Al-Qaisi, Saleh A Khawatreh, Ahmad A Sharadqah, Ziad A Alqadi, Wave File Features Extraction Using Reduced LBP, International Journal of Electrical and Computer Engineering, vol. 8, issue 5, pp. 2780, 2018.
[28] Ziad Alqad, Prof. Yousf Eltous Dr. Ghazi M. Qaryouti, Prof. Mohammad Abuzalata, Analysis of Digital Signal Features Extraction Based on LBP Operator, International Journal of Advanced Research in Computer and Communication Engineering, vol. 9, issue 1, pp. 1-7, 2020.
[29] Ziad Alqadi, Aws Al-Qaisi, Adnan Manasreh, Ahmad Sharadqeh, Digital Color Image Classification Based on Modified Local Binary Pattern Using Neural Network, IRECAP, vol. 9, issue 6, pp. 403-408, 2019.
[30] Ziad A AlQadi Amjad Y Hindi, O Dwairi Majed, PROCEDURES FOR SPEECH RECOGNITION USING LPC AND ANN, International Journal of Engineering Technology Research & Management, vol. 4, issue 2, pp. 48-55, 2020.
[31] Dr. Amjad Hindi, Dr. Majed Omar Dwairi, Prof. Ziad Alqadi, Analysis of Procedures used to build an Optimal Fingerprint Recognition System, International Journal of Computer Science and Mobile Computing, vol. 9, issue 2, pp. 21 – 37, 2020.
[32] Eng. Sameh S. Salma Prof. Ziad A. AlQadi, Eng. Ahmad S. AlOthma, Eng. Mahmoud O. Alleddaw ,Eng. Mohammad Ali Al-Hiar , Eng. Osama T. Ghaza, Investigation of ANN Used to Solve MLR Problem, IJCSMC, vol. 8, issue 5, pp. 38 – 50, 20, 2019.
[33] Eng. Sameh S. Salman Prof. Ziad A. AlQadi, Eng. Ahmad S. AlOthman, Eng. Mahmoud O. Alleddawi, Eng. Mohammad AlHiary, Eng. Osama T. Ghazal, Building Accurate and Efficient Color Image Recognizer, IJCSMC, vol. 8, issue 4, pp. 127 – 135, 2019.
[34] Jamil Al-Azzeh, Ziad Alqadi, Mohammed Abuzalata, Performance Analysis of Artificial Neural Networks used for Color Image Recognition and Retrieving, International Journal of Computer Science and Mobile Computing, vol. 8, issue 2, pp. 20-33, 2019.
[35] Belal Ayyoub, Ahmad Sharadqh, Ziad Alqadi, Jamil Al-azzeh, Simulink based RNN models to solve LPM, International Journal of Research in Advanced Engineering and Technology, vol. 5, issue 1, pp. 49-55, 2019.
[36] Abdullah Al-Hasanat, Haitham Alasha'ary, Khaled Matrouk, Ziad Al-Qadi, Hasan Al-Shalabi, Experimental Investigation of Training Algorithms used in Back propagation Artificial Neural Networks to Apply Curve Fitting, European Journal of Scientific Research, pp. 328-335, 2014.
[37] Ziad AA Alqadi, Investigation and analysis of mat lab models used to solve second order linear ODE, International Journal on Numerical and Analytical Methods in Engineering, vol. 2, issue 1, 2014.

