Performance Evaluation of Online Image Compression Tools

Rupali Sharma[1], Naresh Kumar[2]
[1,2]Department of Computer Science, PTUGZS Campus, Bathinda (Punjab), India
[1]rupali_sharma891@yahoo.com, [2]naresh2834@rediffmail.com

***Abstract*: The growing content of multimedia on the World Wide Web thrive the need to study online image compression. Though many online image compression tools are available but the knowledge of the best tool still is an undiscovered area. This research is about analysing as to which is the best online image compression tool available and to develop a framework using neural network so that large number of images and large number of online image compression tools can be evaluated for their performance. To evaluate the performance of these tools Objective measurement technique is applied by calculating some image quality parameters namely Peak Signal Noise Ratio, Mean Square Error, Normalized Correlation, Maximum Difference. The results of these image quality parameters are rated on Likert scale from 1 to 5 and the average Likert scale points are processed to be fed to Back Propagation Neural Network Model to classify and evaluate the performance of these online image compression tools.**

***Keywords*: Online Image Compression Tools, Image Quality parameters, Neural Network.**

1. INTRODUCTION

The basic idea behind the research is to compress the image maintaining its quality mathematically and physically. The need of growing graphics on the internet has led to emergence of online image compression tools that compress the image online and can be uploaded on the website for commercial or personal use. Image quality is a characteristic of an image that measures the perceived image degradation as compared to an ideal or perfect image. Images when processed introduce some amounts of distortion or artifacts in the signal. By considering a large set of images, and determining a quality measure for each of them, statistical methods can be used to determine an overall quality measure of the compression method.

1.1 Measuring Image Quality:

It is important to measure the quality of the image for image processing application. How good the image compression algorithm is depends upon the quality of compressed image produced on application of that algorithm. There are basically two approaches for image Quality measurement [1].

1. Subjective measurement
2. Objective measurement

Subjective Measurement

A number of observers are selected, tested for their visual capabilities, shown a series of test scenes and asked to score the quality of the scenes. It is the only "correct" method of quantifying visual image quality.

Objective Measurement

- **Mean Square Error**

MSE is the average squared difference between a reference image and a distorted image. The large value of MSE means that image is poor quality

$$MSE = \frac{1}{MN}\sum_{m=1}^{M}\sum_{n=1}^{N}(x(m,n)-x'(m,n))^2$$

- **Peak Signal Noise Ratio**

PSNR, defines ratio between the maximum possible power of a signal and the power of corrupting noise The large value of Peak Signal to Noise Ratio (PSNR)[2] means that image is of good quality.

$$PSNR = 10\log\frac{255^2}{MSE}$$

- **Maximum Difference (MD)**

The maximum difference is the maximum difference of the pixels in original and compressed image among all differences. The large value of Maximum Difference (MD) means that image is poor quality.

$$MD = MAX(|x(m,n)-x'(m,n)|)$$

- **Normalized Absolute Error (NAE)**

Normalized absolute error is a measure of how far is the decompressed image from the original image with the value of zero being the perfect fit. Large value of NAE indicates poor quality of the image.

$$NAE = \frac{\sum_{m=1}^{M}\sum_{N=1}^{N}|\, x(m,n) - x(m,n)\,|}{\sum_{m=1}^{M}\sum_{n=1}^{N}|\, x(m,n)\,|}$$

- **Normalized Correlation (NK)**

The closeness between two digital images can also be quantified in terms of correlation function. The large value of NK means that image is of good quality [3].

$$NormalizedCorrelation(NK) = \frac{\sum_{m=1}^{M}\sum_{n=1}^{N}(x(m,n) - x'(m,n))}{\sum_{m=1}^{M}\sum_{n=1}^{N}x(m,n)^2}$$

- **Average Difference (AD)**

A lower value of Average Difference (AD) gives a "cleaner" image as more noise is reduced i.e. lower the average difference better is the quality of the image.[1]

$$AverageDifference(AD) = \frac{1}{MN}\sum_{m=1}^{M}\sum_{n=1}^{N}(x(m,n) - x'(m,n))$$

- **Structural Content (SC)**

It is an estimate of the similarity of the structure of two signals. Large value of SC means that the image is of poor quality.

$$StructuralCorrelation\,/\,Content(SC) = \frac{\sum_{m=1}^{M}\sum_{n=1}^{N}(x(m,n))^2}{\sum_{m=1}^{M}\sum_{n=1}^{N}(x'(m,n))^2}$$

1.2 Online Image Compression Tools:

These are the tools that compress the image online. There are various image compression techniques available that compress the image. The basic advantage of online image compression tool is that there is no need to download these tools saving memory space on one's computer and these tools also hold the advantage of directly uploading the resultant compressed image for personal or commercial use. The images compressed can also be saved for future use. The different tools can reduce the size of various images of various formats and can produce customized results on the user preference. For example image compression can be done by reducing the size of the image as specified by the user. These tools can optimize, compress and resize the image as per the need.

1.3 Study of neural Network:

The term neural network usually refers to a network or circuit of biological neurons. The modern usage of the term often refers to artificial neural networks, which are composed of artificial neurons or nodes. Artificial neural networks are composed of interconnecting artificial neurons. Artificial neural networks may either be used to gain an understanding of biological neural networks, or for solving artificial intelligence problems without necessarily creating a model of a real biological system.[8]

2. METHODOLOGY

2.1 Overview of proposed Methodology

1. The first step is to identify 4 online image compression tools that will be used to compress the images online. The dataset will be applied on this image compression tools and there after the resultant compressed images will be monitored for their quality to ascertain the best online image compression tool.
2. The second step is to determine the input i.e. selecting the Image dataset for gray scale images on which online compression tool will be run. The data set selected has to be of same dimensions and format.
3. Next step is to determine the image quality measuring parameters to be implemented for objective measurement. The results of these parameters will be analysed for classifying and performance evaluation of online image compression tools.
4. Develop a likert scale i.e. rate the values of quality measuring parameters on the scale of 1-5, where 5 represents best case and 1 represents worst case for performance evaluation
5. Run Neural Network on the values obtained by application of Likert scale and develop classification.

2.2 Select four Online Image Compression Tools

Web Resizer:

Web Resizer is one of the most effective tools for resizing your images for free and edits your photos so that it can be easily attached to your emails or web pages. It allows uploading of images of size less than 5 MB.

Shrink Pictures:

Shrink Pictures makes image optimization very simple and comprehensive.. Shrink Pictures permits you to upload images at a maximum size of 6Mb. The maximum dimension

of the image should be of 1000 pixel and uses JPEG compression technique to compress the image.

Jpeg Optimizer:

JPEG-Optimizer is a free online tool for resizing and compressing your digital photos and images for displaying on the web in forums or blogs, or for sending by email.

Dynamic Drive:

Dynamic Drive is a simple tool that helps you to instantly compress images of GIF, JPG or PNG format. Moreover, it also enables to convert your images from one format to another. However, the upload limit for any image is 300 KB.

2.3 GRAY SCALE IMAGE DATA SET

Fig 1 Sample Images

2.4 Process data on all image compression tools

Table 1: Index of Web Compressed Grayscale Images

Online Image Compression Tool	Index Number
Dynamic Drive	1-10
JPEG Optimizer	11-20
Shrink Pictures	21-30
Web Resizer	31-40

2.5 Apply Performance Evaluator

After compressing all the images on all the four tools we have a set of 40 images.

a. Mean Square Error
b. Peak Signal Noise Ratio
c. Normalized Co-relation
d. Average Difference
e. Structural Content
f. Maximum Difference
g. Normalized Absolute Error

Divide the values into five parts by calculating the maximum and minimum value for each of the parameter.

2.6 Develop Likert Chart

Likert Scale is developed to categorize the images based on the quality which in turn is determined by the value of seven mentioned parameters. The Likert Scale was developed using point rating system.

Table 2: Image Quality Rating Table

Quality	Rating
Excellent/Very Good	5
Good	4
Average	3
Below Average	2
Poor/Unacceptable	1

3. RESULTS

Accuracy table is obtained by changing the number of hidden layers and calculating the accuracy or success rate. The below table was obtained by repeatedly changing the number of hidden layers on the trainlm function and recording the accuracy percentage on each change. The below table indicates that best accuracy rate was obtained at 10 hidden layers i.e. of 97.5%.

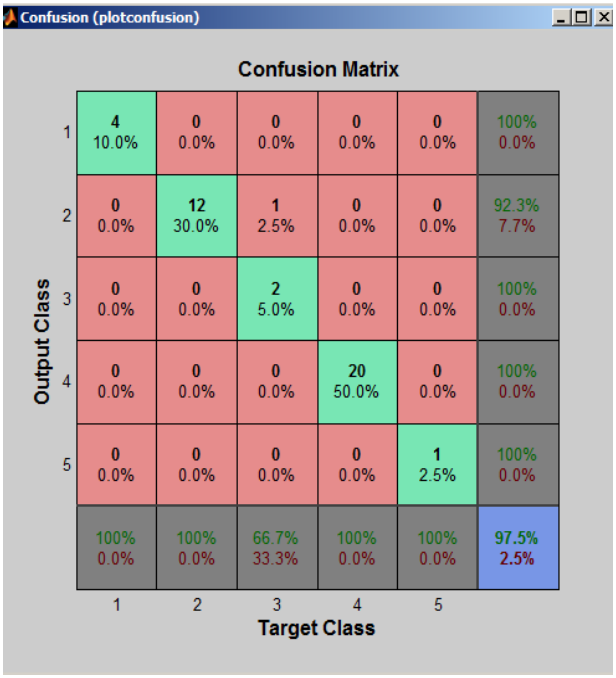

Fig 2: Confusion matrix for Greyscale Images

3.1 Indices for greyscale images

The indices tables thus obtained show the classification of each image.

Table 3: Indices Table for Greyscale Images

	1	2	3	4	5
1	10,11,39,40				
2		1,3,5,6,7,8,9,23,34,36,37,38			
3			2,13,15		
4				4,12,14,16,17,18,19,20,21,22,24,25,26,27,29,30,31,32,33,35	
5			28		

The table indicates that Image no. 10, 11, 39 & 40 are of excellent quality, Image no. 1,3,5,6,7,8,9,23,34,36,37,38 are of Good quality, Image No. 2,13,15 are of average quality and Image no. 4,12,14,16,17,18,19,20,21,22, 24,25,26,27, 29, 30,31,32,33,35 is of below average quality. Neural Network was unable to classify Image no. 28.

Following inferences can be drawn:

1) Dynamic Drive Produces one image of excellent quality, 7 images of good quality and one each image of average and below average quality.
2) Jpeg Optimizer Produces one image of excellent quality, 2 images of average and seven images of below average quality.
3) Shrink pictures produces one image of good quality and 8 images of below average and one image remain unclassified.
4) Web resizer produces 2 images of excellent quality, 4 of good quality and remaining 4 of below average quality.

3.2 Ratings of Online Image Compression Tools

Table shows the final result depicting the ranking of all four online image compression tools on the basis of above study.

Table 4: Ranking Table for Greyscale Images

Online Image Compression Tool	Ranking	Remarks
Web Resizer	1	Majority of Images lie in excellent or good quality with 2 images of Excellent quality
Dynamic Drive	2	Though the number of images lying in excellent or good quality is one more than web resizer but web resizer has two images of excellent quality in comparison to one image of excellent quality of dynamic drive
JPEG Optimizer	3	Produces only one image of excellent quality, rest images are of average or below average
Shrink pictures	4	No image of excellent quality, only one image of good quality and remaining of below average quality &one image going unclassified

Image Quality Parameters:

Index	MSE	PSNR	NK	AD	SC	MD	NAE
1	35.8804	35.5822	0.9989	0.0066	1.0003	35	0.0304
2	8.6271	38.7721	1.0005	0.0014	0.9985	25	0.0145
3	13.5523	36.8107	1.0023	-0.1811	0.9948	25	0.0188
4	143.5046	26.5621	0.9956	-0.2848	1.0025	61	0.071
5	79.2457	29.141	0.9967	0.0238	1.0031	55	0.0457
6	38.2558	32.3038	0.9985	-0.0167	1.0004	55	0.0376
7	31.4688	33.152	0.9986	0.0381	1.001	45	0.0268
8	163.2747	26.0016	0.9932	0.0163	1.0048	85	0.0699
9	154.0509	26.2542	0.994	0.0373	1.0036	66	0.0731
10	22.0223	34.7022	0.9998	-0.0452	0.9991	48	0.023
11	35.8804	35.5822	0.9989	0.0066	1.0003	35	0.0304
12	8.6271	38.7721	1.0005	0.0014	0.9985	25	0.0145
13	13.5523	36.8107	1.0023	-0.1811	0.9948	25	0.0188
14	113.5671	27.5783	0.9981	-0.2869	0.9987	49	0.0628
15	79.2457	29.141	0.9967	0.0238	1.0031	55	0.0457
16	38.2558	32.3038	0.9985	-0.0167	1.0004	55	0.0376
17	31.4688	33.152	0.9986	0.0381	1.001	45	0.0268
18	163.2747	26.0016	0.9932	0.0163	1.0048	85	0.0699
19	154.0509	26.2542	0.994	0.0373	1.0036	66	0.0731
20	16.6925	35.9056	0.9999	-0.0489	0.9992	40	0.02
21	0.5735	50.5456	1	-0.0016	0.9999	6	0.0033
22	0.2481	54.1841	1.0001	-8.17E-04	0.9999	4	0.0018
23	0.3398	52.8183	1.0001	7.69E-04	0.9999	4	0.0022
24	2.0827	44.9446	0.9999	-0.0901	1.0001	8	0.0079
25	0.81	49.0457	0.9997	0.0097	1.0005	10	0.0042
26	0.7095	49.6211	1.0001	0.003	0.9998	5	0.0048
27	0.5623	50.6311	1	6.01E-04	0.9999	6	0.0031
28	1.7127	45.7941	0.9997	0.0053	1.0006	12	0.007
29	2.0714	44.9682	0.9995	0.0034	1.0008	12	0.0081
30	0.3682	52.4703	1	-4.33E-04	0.9999	8	0.0023
31	5.0351	41.1107	1.0002	0.0219	0.9994	18	0.0111
32	0.6105	50.274	1.0001	-0.024	0.9997	6	0.0036
33	0.8393	48.8915	0.9999	-0.0223	1.0002	9	0.0039
34	8.0315	39.0828	1.0006	-0.1661	0.9984	24	0.0164
35	6.1509	40.2414	1.0005	-0.0014	0.9987	19	0.0128
36	3.7742	42.3626	1.0004	0.0015	0.999	13	0.0119
37	3.8246	42.3049	1.0007	-0.0198	0.9984	14	0.0093
38	11.9498	37.3572	1.0021	-0.0105	0.9951	21	0.019
39	9.7711	38.2314	1.0012	-0.002	0.997	22	0.0181
40	2.8859	43.5279	1.0001	0.004	0.9996	15	0.0081

Likert Scale Rating:

Index No.	MSE	PSNR	NK	AD	SC	MD	NAE
1	4	2	4	1	3	4	3
2	5	2	4	2	3	3	4
3	4	2	4	1	3	4	3
4	5	3	5	1	4	4	5
5	5	2	0	4	0	4	4
6	2	1	4	0	4	3	1
7	3	1	4	1	1	2	2
8	4	2	4	1	3	2	3
9	5	2	4	1	2	3	4
10	0	1	0	1	1	1	1
11	1	1	1	1	1	2	1
12	5	3	5	1	4	4	5
13	5	2	4	2	3	3	4
14	5	5	4	1	3	5	5
15	5	5	4	1	3	5	0
16	5	5	4	1	3	5	5
17	5	4	4	2	3	5	5
18	5	5	4	1	3	5	5
19	5	5	4	1	3	5	5
20	5	5	4	1	3	5	5
21	5	4	4	1	3	5	5
22	5	4	4	1	3	5	5
23	5	2	0	4	0	4	4
24	5	5	4	1	3	5	5
25	5	3	4	1	3	5	5
26	5	5	4	1	3	5	5
27	5	5	4	1	3	5	5
28	5	3	5	4	4	4	4
29	5	3	5	1	4	5	5
30	5	3	4	1	3	5	5
31	5	3	5	1	4	5	5
32	5	3	5	1	5	4	4
33	5	3	5	1	4	4	4
34	1	1	2	5	2	2	1
35	5	4	4	1	3	5	5
36	3	1	4	1	1	2	2
37	4	2	4	1	3	2	3
38	5	2	4	1	2	3	4
39	0	1	0	1	1	1	1
40	1	1	1	1	1	2	1

Scores:

Index No.	1	2	3	4	5
1	0	1	0	0	0
2	0	0	1	0	0
3	0	1	0	0	0
4	0	0	0	1	0
5	0	1	0	0	0
6	0	1	0	0	0
7	0	1	0	0	0
8	0	1	0	0	0
9	0	1	0	0	0
10	1	0	0	0	0
11	1	0	0	0	0
12	0	0	0	1	0
13	0	0	1	0	0
14	0	0	0	1	0
15	0	0	1	0	0
16	0	0	0	1	0
17	0	0	0	1	0
18	0	0	0	1	0
19	0	0	0	1	0
20	0	0	0	1	0
21	0	0	0	1	0
22	0	0	0	1	0
23	0	1	0	0	0
24	0	0	0	1	0
25	0	0	0	1	0
26	0	0	0	1	0
27	0	0	0	1	0
28	0	0	0	0	1
29	0	0	0	1	0
30	0	0	0	1	0
31	0	0	0	1	0
32	0	0	0	1	0
33	0	0	0	1	0
34	0	1	0	0	0
35	0	0	0	1	0
36	0	1	0	0	0
37	0	1	0	0	0
38	0	1	0	0	0
39	1	0	0	0	0
40	1	0	0	0	0

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