

Comparison of Online Image Compression Tools in Grayscale and Colored Images

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Abstract— The growing content of multimedia on the world wide web thrive the need to study online image compression. There are many online image compression tools are available but the knowledge of the best tool still is an undiscovered area. This research is about analyzing as to which is the best online image compression tool available for coloured images 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.

Index Terms— Online Image Compression Tools, Image Quality parameters, Neural Network.

I. 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.

A. 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[8].

1. Subjective measurement
2. Objective measurement

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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)[4] 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[7].

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

• **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[8].

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

• **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.

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

B. 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.

C. 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[6].

Artificial Neural Network: The neural network is formed by a set of neurons interconnected with each other through the synaptic weights. The basic neural network consists of 3 layers.

- 1) **Input layer:** The input layer consists of source nodes. This layer captures the features pattern for classification. The number of nodes in this layer depends upon the dimension of feature vector used at the input.
- 2) **Hidden layer:** This layer lies between the input and output layer. The number of hidden layers can be one or more. Each hidden layers have a specific number of nodes (neurons) called as hidden nodes or hidden neurons. The output of this layer is supplied to the next layer.
- 3) **Output layer:** It results the output after features is passed through neural network. The set of outputs in

output layer decides the overall response of the neural network for a supplied input features.

II. METHODOLOGY

A. 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.
2. The second step is to determine the input i.e. selecting the Image dataset for grayscale images and coloured images on which online compression tool will be run.
3. Next step is to determine the image quality measuring parameters to be implemented for objective measurement.
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.

B. Select four Online Image Compression Tools

- I. **Web Resizer:** It allows uploading of images of size less than 5 MB.
- II. **Shrink Pictures:** Shrink Pictures permits you to upload images at a maximum size of 6Mb. The maximum dimension of the image should be of 1000 pixel.
- III. **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.
- IV. **Dynamic Drive:** It enables to convert your images from one format to another. However, the upload limit for any image is 300 KB.

IMAGE DATA SET



Fig 1 Sample Images

C. Process data on all image compression tools

Table 1: Index of Web Compressed Grayscale and Colored Images

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

D. Apply Performance Evaluator

After compressing all the images on all the four tools we have a set of 40 images of grayscale and colored each.

- Mean Square Error
- Peak Signal Noise Ratio
- Normalized Co-relation
- Average Difference

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

E. 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.

III. RESULTS

A. Confusion Matrix for Grayscale Images:

Accuracy table is obtained by changing the number of hidden layers and calculating the accuracy or success rate. The below table indicates that best accuracy rate was obtained at 10 hidden layers i.e. of 97.5%.

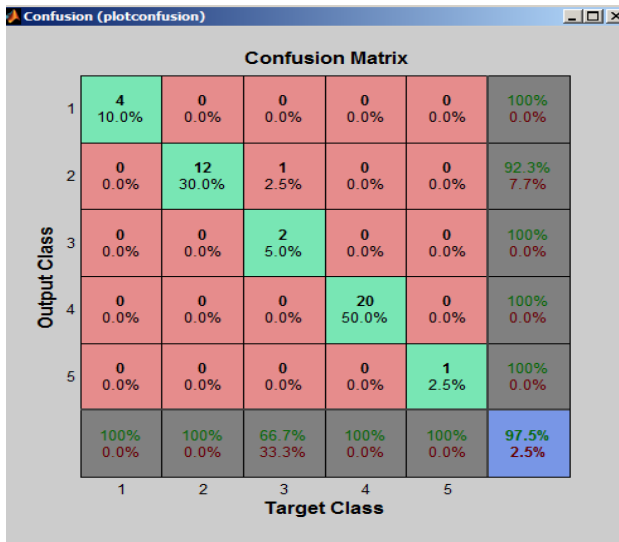


Fig 2: Confusion matrix for Grayscale Images

Classification for Grayscale Images:

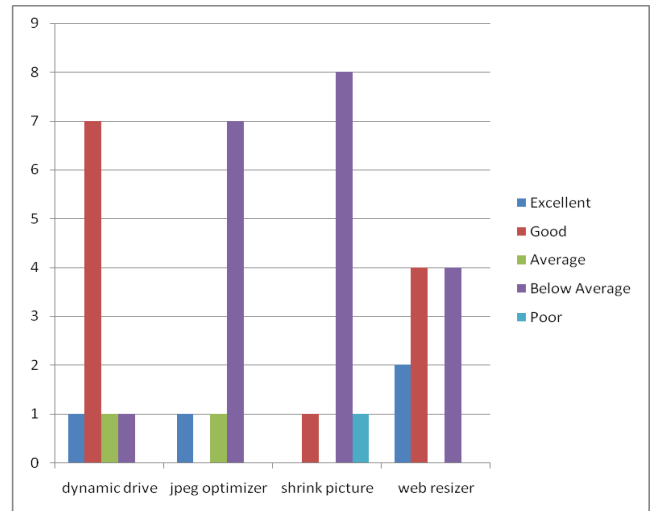


Fig 3: Classification for Grayscale Images

Following inferences can be drawn from Figure 3:

- Dynamic Drive** produces 1 image of **excellent** quality, 7 images of **good** quality, 1 image of **average** and 1 image of **below average** quality.
- Jpeg Optimizer** produces 1 image of **excellent** quality, 1 images of **average**, 7 images of **below average** quality and 1 image is **unclassified**.
- Shrink pictures** produces 1 image of **good** quality, 8 images of **below average** and 1 image is of **poor** quality.
- Web resizer** produces 2 images of **excellent** quality, 4 images of **good** quality and 4 images of **below average** quality.

Online Image Compression Tool	Ranking
Web Resizer	1
Dynamic Drive	2
JPEG Optimizer	3
Shrink pictures	4

B. Confusion Matrix for Colored Images

Accuracy table is obtained by changing the number of hidden layers and calculating the accuracy or success rate. The below table indicates that best accuracy rate was obtained at 10 hidden layers i.e. of 95%.

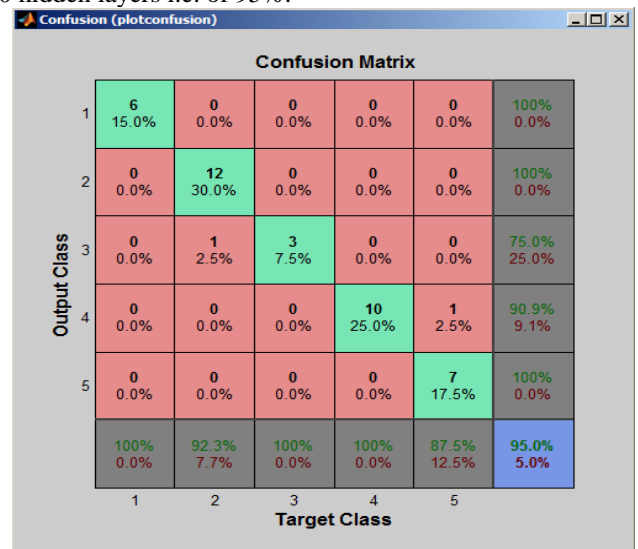


Fig 4: Confusion matrix for coloured Images

Comparison of Online Image Compression Tools in Grayscale and Colored Images

Classification for Colored Images:

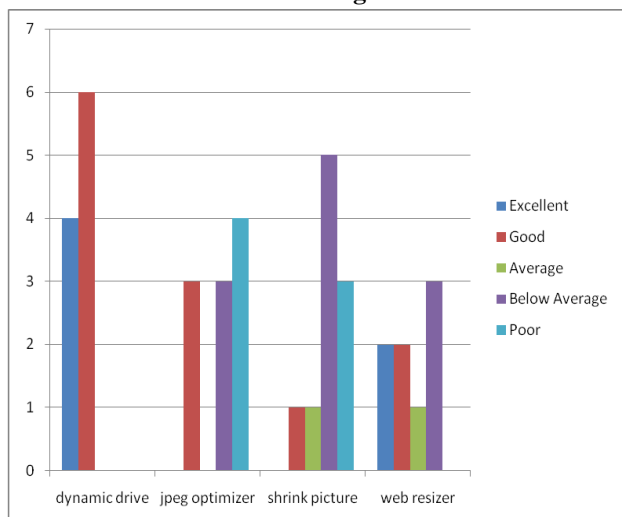


Fig 5: Classification for coloured Images

- 1) **Dynamic Drive** Produces **4** images of **excellent** quality, **6** images of **good** quality.
- 2) **Jpeg Optimizer** Produces **3** images of **good** quality, **3** images of **below average** quality and **4** images of **poor** quality.
- 3) **Shrink pictures** produces **1** image of **good** quality, **1** image of **average** quality, **5** images of **below average** quality and **3** images of **poor** quality.
- 4) **Web resizer** produces **2** images of **excellent**, **2** images of **good**, **1** images of **average** and **3** images of **below average** quality and **2** images are **unclassified**.

Table 3: Ranking Table for Coloured Images

Online Image Compression Tool	Ranking
Dynamic Drive	1
Web Resizer	2
JPEG Optimizer	3
Shrink pictures	4

Following inferences can be drawn from Figure 4:

Image Quality Parameters for Grayscale Images

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

Image Quality Parameters for Colored Images:

Index	MSE	PSNR	NK	AD	SC	MD	NAE
1	66.1386	29.9263	0.9971	-0.0104	1.0021	62	0.0446
2	38.2803	32.3011	0.9991	-0.1067	0.9999	57	0.0325
3	35.956	32.5731	0.999	-0.063	1	61	0.0315
4	83.8671	28.8949	0.9953	0.0741	1.0051	63	0.0499
5	20.3026	35.0553	0.9992	-8.65E-04	1.0004	46	0.022
6	30.3035	33.3159	0.9987	0.0107	1.0008	44	0.0259
7	108.4186	27.7798	0.9957	-0.0248	1.0027	59	0.0563
8	10.7973	37.7977	0.9988	0.0142	1.0015	37	0.019
9	17.9687	35.5856	0.9988	-0.034	1.0004	38	0.0296
10	45.5527	31.5457	0.9985	0.0767	1.0016	68	0.0269
11	66.1386	29.9263	0.9971	-0.0104	1.0021	62	0.0446
12	38.2803	32.3011	0.9991	-0.1067	0.9999	57	0.0325
13	35.956	32.5731	0.999	-0.063	1	61	0.0315
14	83.8671	28.8949	0.9953	0.0741	1.0051	63	0.0499
15	17.0492	35.8138	0.9989	0.0456	1.0013	44	0.0203
16	30.3035	33.3159	0.9987	0.0107	1.0008	44	0.0259
17	108.4186	27.7798	0.9957	-0.0248	1.0027	59	0.0563
18	9.0423	38.568	0.9987	0.0819	1.0018	32	0.0174
19	14.6764	36.4646	0.9986	0.065	1.0012	40	0.0273
20	45.5527	31.5457	0.9985	0.0767	1.0016	68	0.0269
21	1.0311	47.9977	0.9999	-0.0063	1.0001	13	0.0051
22	0.7879	49.166	1	-0.0254	1	9	0.0042
23	0.5517	50.7135	1	-0.0023	1.0001	6	0.0035
24	1.2707	47.0902	0.9995	-0.0109	1.0009	9	0.0058
25	0.3924	52.1935	1	-0.0038	1	8	0.0024
26	0.5175	50.992	0.9998	0.0149	1.0003	6	0.0029
27	1.2965	47.0031	0.9998	7.93E-04	1.0002	9	0.0059
28	0.3111	53.2014	0.9997	0.0122	1.0005	7	0.0024
29	0.3274	52.9797	0.9999	-0.0102	1.0001	7	0.003
30	0.8822	48.6751	0.9998	0.0344	1.0005	8	0.0035
31	5.6867	40.5822	1.0006	-0.0192	0.9984	22	0.013
32	4.6825	41.426	1.0004	-0.0513	0.9989	14	0.0111
33	4.5963	41.5067	1.0004	-0.0065	0.999	16	0.0112
34	8.2304	38.9766	1.0001	0.0054	0.9994	22	0.0158
35	2.1979	44.7108	1.0001	-0.0026	0.9996	12	0.0071
36	3.9468	42.1683	1.0001	0.0122	0.9995	13	0.0093
37	80.1728	39.0071	1.0012	-0.004	0.9972	18	0.0156
38	1.4909	46.3964	0.9996	0.0388	1.0006	13	0.0067
39	2.4006	44.3277	1	0.0134	0.9997	15	0.0104
40	4.7135	41.3973	0.9998	0.0636	1.0003	15	0.0087

Scores for Grayscale images:

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

Scores for Colored Images:

Index No.	1	2	3	4	5
1	1	0	0	0	0
2	0	1	0	0	0
3	1	0	0	0	0
4	0	1	0	0	0
5	0	1	0	0	0
6	1	0	0	0	0
7	0	1	0	0	0
8	0	1	0	0	0
9	1	0	0	0	0
10	0	1	0	0	0
11	0	1	0	0	0
12	0	1	0	0	0
13	0	1	0	0	0
14	0	0	0	1	0
15	0	0	0	0	1
16	0	0	0	0	1
17	0	0	0	1	0
18	0	0	0	0	1
19	0	0	0	0	1

IV CONCLUSION

From the results obtained, mentioned in the previous chapter, it can be clearly stated that

- 1) Dynamic Drive and Web resizer is the best online image compression tool among all four online image compression tools.
- 2) Shrink pictures don't produce the desired results for compressed images and the results are unacceptable.
- 3) Now we have a framework that can test any number of images and, can classify and evaluate the performance of any number of online image compression tools.
- 4) It is an automated framework that analyses the results scientifically thus providing a proven fact for the comparison of online image compression tool.
- 5) The quality of the compressed image is not calculated on the basis of human perception but widely known and accepted seven image quality parameters.
- 6) The interpretation of the results of image quality parameters which is done mostly manually, is done by the back propagation model of ANN by implementing Levenberg-Marquardt (trainlm) method.
- 7) Large input dataset is used so that it increases the area of evaluation and also facilitated ANN model as ANN remains inefficient on lesser number of images.

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20	0	0	0	1	0
21	0	0	0	0	1
22	0	0	0	0	1
23	0	1	0	0	0
24	0	0	0	0	1
25	0	0	0	1	0
26	0	0	0	1	0
27	0	0	0	1	0
28	0	0	1	0	0
29	0	0	0	1	0
30	0	0	0	1	0
31	0	0	0	0	1
32	0	0	0	1	0
33	0	0	0	1	0
34	1	0	0	0	0
35	0	0	1	0	0
36	0	1	0	0	0
37	0	1	0	0	0
38	1	0	0	0	0
39	0	1	0	0	0
40	0	0	1	0	0

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