ALL COLORS HAVE DIFFERENT EFFECTS ON IMAGE SIZE A HELPING APPROACH FOR IMAGE OPTIMIZATION

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ABSTRACT

To increase the image optimization rate is a big problem especially for web-based application and big data. There are many guidelines and techniques to optimize the image. But still, there is a need to increase the image optimization rate. Among image optimization techniques most common is image cropping, optimization of image dimensions, deletion of irrelevant image layers and headers and save the image as "save for web". Save the image for the web is mostly used by web designers. Among these techniques, we have proposed the image optimization technique by selecting the appropriate optimized colors. We use the Microsoft windows paint and compare the different images with different colors. We conclude that color is a prominent factor that affects the image size. Some colors are found to have very much size as compared to other colors. We also find that some colors having a difference of 24%. Most of the colors have 3% to 8% difference with each other. This appropriate color selection boosts the image optimization rate of an image.

1. INTRODUCTION

Now in the era of big data and web, it is a problem to optimize the images with extreme limit without reducing the quality of the image. When images are not optimized they create the problem to store, upload, download and to share the images.

There are different image optimization techniques to reduce the image size. Some of these techniques optimize the image and also reduce the quality of images. However, some techniques optimize the images without losing the quality of the image. It is always an interest of the web designers to decrease the size of an image more and more. The optimized image has many advantages over the non-optimized image [6]. Some of the advantages are;

- Fast uploading
- Fast downloading
- Fast response
- Efficient SEO
- Less bandwidth usage etc.

Image optimization techniques work better and our proposed guidelines support to decrease the size of an image before optimizing an image.

We proposed guidelines to select colors according to their size. We have introduced in our research that colors effects on image size. If someone chose the color according to our guidelines, then optimized images are produced. We use the Microsoft windows paint and select colors one by one and save the images. After the image creation, we evaluate the images size. During experiments, we have found a different hidden pattern in colors. During the experiments with PNG images, all colors are observed to have different size. The red color is observed to have more size as compared to Green and Green observed to have more size as compared to Blue. Red with Green occupies more space as compared to Red with Blue. Green with Red occupies more space as compared to Green with Blue.

Blue with Red occupied more space as compared to Blue with Green.

2. LITERATURE REVIEW:

There are many image optimization techniques. Some of the image optimization techniques are mentioned in this section.

2.1 Selection of image type:

Image type is most common to optimize the images. Selection of correct image type is always helpful in process of image optimization. There are many image types like JPG, PNG, GIF and TIFF etc. PNG (Portable Network Graphic) is used when it is a need to support the lossless data optimization. PNG is mostly preferred for website images. When there are many logos, icons and text in the images, PNG is an ideal choice. PNG is very useful for images with transparent backgrounds. JPG (Joint Photographic Experts Group) is mostly used when there is a big demand of high quality images [1].

2.2 Vector graphic images:

Vector graphics images are formed by geometrical shapes like curves, points and lines etc. These images have programming source code and code can be optimized easily. Vectored images are easily modifiable. Size of vectored images can be optimized easily because shapes are drawn with source code [2].

2.3 Crop the image:

Image cropping is a very famous technique of image optimization. We crop the image and remove the irrelevant background and objects from the image. This leads to form an image with low size [2].

2.4 Dimensions of image:

Dimension of an image is represent by X and Y axis. Axis of the image plays key role in the size of an image. As we increase the X or Y axis of an image, then its size is also increased. Similarly to optimize the image, we decrease the X and Y axis [3-5].

2.5 Deleting irrelevant layers:

An image is formed of different layers. Sometimes some unnecessary layers are in image. These unnecessary layers are removed to optimize the image [4].

2.6 Save for web:

Mostly all the image editing tools have an option to save the image as "save for web". This is an option to save the images with optimized size. This technique is ideal for image optimization for web designers [3].

2.7 Optimization of headers:

All JPG images have an optional exchangeable image format header. This header contains different information about image. Copyright of the image, author of the image, time of image capturing, camera specification and some other metadata of image is stored in header of the image. Most of the time designers remove the header from images to optimize the image because header does not affect the display.

2.8 Progressive encoding:

With the default baseline encoding, a web browser renders a JPG image completely. It starts rendering the image from the top to the bottom as and when image downloads. Progressive encoding optimizes the JPG images about 10 KB. An important advantage of this technique is that users can view rendered images faster [8].

2.9 Transparent Background:

Most of the brand logos are with transparent backgrounds. An image with transparent background has less number of pixels. Transparent background is an ideal for image optimization [7].

3. METHODOLOGY:

During the experiments, we open the Microsoft windows paint and set the dimensions of the image. The dimension of the image is taken by both keeping the aspect ratio and without keeping the aspect ratio. We start with X and Y axis as 1 and then we increase the axis by 2*2 and then 500*500, 1000 *1000 and 500 * 1000. We create the different images by selecting the different hue, saturation, and luminance of the color. After that, we save the image and evaluate the size of the image with other images having different colors.

4. DATA SET AND EXPERIMENTS

There are thousands of color combinations used as data as discussed below [16-18];

Single color:

Red – Total 256 colors
Green – Total 256 colors
Blue – Total 256 colors

Two colors:

Red + Green – Total 196608 colors
Red + Blu - Total 196608 colors
Blue + Green - Total 196608 colors

Three colors:

Red + Green + Blue – Total 589824 colors

It is very difficult to manage such a large number of colors and images. So we adopt the simple boundary value testing technique to evaluate the colors [20]. We test the colors on their boundaries. Selected boundaries are as following;

Min is the minimum value of color.

Min+ is the one value above the minimum value of color. Nominal is the middle value of color. Max- is the one value below the maximum value of color. Max is the maximum value of color.

		R
1	Min	0
2	Min+	1
3	Nominal	127
4	Max-	254
5	Max	255

		G
1	Min	0
2	Min+	1
3	Nominal	127
4	Max-	254
5	Max	255

		B
1	Min	0
2	Min+	1
3	Nominal	127
4	Max-	254
5	Max	255

Table 1-3: Boundary values for Red, Green and Blue color (Single color)

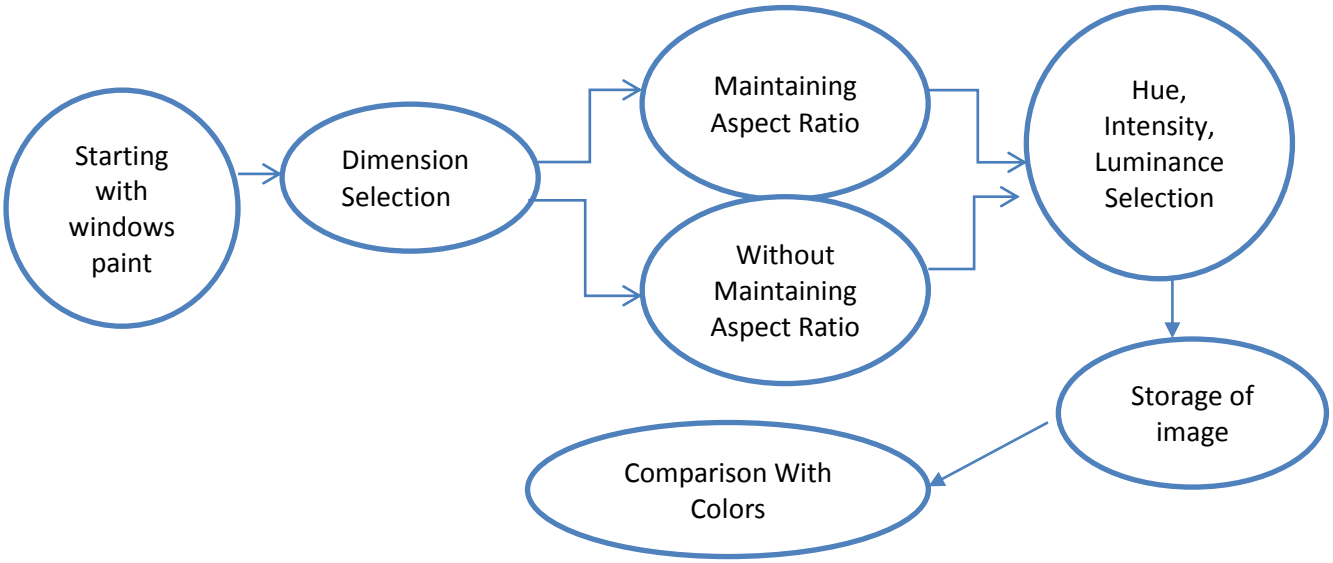

Figure 1: Illustration of research methodology

		R	G
1	Min	0	0
2	Min+	1	1
3	Nominal	127	127
4	Max-	254	254
5	Mx	255	255

Table 4: Boundary values for red and green color (two colors)

		R	B
1	Min	0	0
2	Min+	1	1
3	Nominal	127	127
4	Max-	254	254
5	Max	255	255

Table 5: Boundary values for Red and Blue color (two colors)

		G	B
1	Min	0	0
2	Min+	1	1
3	Nominal	127	127
4	Max-	254	254
5	Max	255	255

Table 6: Boundary values for Green and Blue color (two colors)

		R	G	B
1	**Min**	0	0	0
2	**Min+**	1	1	1
3	**Nominal**	127	127	127
4	**Max-**	254	254	254
5	**Max**	255	255	255

Table 7: Boundary values for Red, Green and Blue color (three colors)

					Size				
	Colour			Mixture	Dimension 1*1	Dimension 2*2	Dimension 500*500	Dimension 1000*1000	Dimension 500*1000
ID	R	G	B						
1	0	0	0	No Colour	119	118	3402	13216	6675
2	1	0	0	R	119	123	4806	16571	9477
3	127	0	0	R	119	123	4806	16571	9477
4	254	0	0	R	119	123	4806	16571	9477
5	255	0	0	R	119	123	4806	16571	9477
6	0	1	0	G	119	122	4168	15076	8199
7	0	127	0	G	119	122	4168	15076	8199
8	0	254	0	G	119	122	4168	15076	8199
9	0	255	0	G	119	122	4168	15076	8199
10	0	0	1	B	119	122	4167	15074	8197
11	0	0	127	B	119	122	4167	15074	8197
12	0	0	254	B	119	122	4167	15074	8197
13	0	0	255	B	119	122	4167	15074	8197
14	127	127	0	R+G	119	123	4806	16572	9478
16	127	1	0	R+G	119	123	4806	16572	9478
17	127	254	0	R+G	119	123	4806	16572	9478
18	127	255	0	R+G	119	123	4806	16572	9478
20	1	127	0	R+G	119	123	4806	16572	9478
21	254	127	0	R+G	119	123	4806	16572	9478
22	255	127	0	R+G	119	123	4806	16572	9478
24	127	0	1	R+B	119	123	4419	15640	8700
25	127	0	127	R+B	119	123	4419	15640	8700
26	127	0	254	R+B	119	123	4419	15640	8700
27	127	0	255	R+B	119	123	4419	15640	8700
29	1	0	127	R+B	119	123	4419	15640	8700
30	254	0	127	R+B	119	123	4419	15640	8700
31	255	0	127	R+B	119	123	4419	15640	8700
33	0	127	1	G+B	119	122	4169	15077	8200
34	0	127	127	G+B	119	122	4169	15077	8200
35	0	127	254	G+B	119	122	4169	15077	8200

36	0	127	255	G+B	119	122	4169	15077	8200
38	0	1	127	G+B	119	122	4169	15077	8200
39	0	254	127	G+B	119	122	4169	15077	8200
40	0	255	127	G+B	119	122	4169	15077	8200
42	127	127	1	R+G+B	119	123	4419	15640	8701
43	127	127	127	R+G+B	119	123	4419	15640	8701
44	127	127	254	R+G+B	119	123	4419	15640	8701
45	127	127	255	R+G+B	119	123	4419	15640	8701
47	1	127	127	R+G+B	119	123	4419	15640	8701
48	254	127	127	R+G+B	119	123	4419	15640	8701
49	255	127	127	R+G+B	119	123	4419	15640	8701
51	127	1	127	R+G+B	119	123	4419	15640	8701
52	127	254	127	R+G+B	119	123	4419	15640	8701
53	127	255	127	R+G+B	119	123	4419	15640	8701

Table 8: Illustration of images size (Type: PNG) with different dimension

					Size				
	Colour			**Mixture**	**Dimension 1*1**	**Dimension 2*2**	**Dimension 500*500**	**Dimension 1000*1000**	**Dimension 500*1000**
ID	R	G	B						
1	1	0	0	R	631	631	4723	16503	8691
2	127	0	0	R	634	634	4726	16506	8694
3	254	0	0	R	635	635	4727	16507	8695
4	255	0	0	R	635	635	4727	16507	8695
5	0	1	0	G	631	631	4723	16503	8691
6	0	127	0	G	634	634	4726	16506	8694
7	0	254	0	G	635	635	4727	16507	8695
8	0	255	0	G	635	635	4727	16507	8695
9	0	0	1	B	631	631	4723	16503	8691
1	0	0	127	B	634	634	4726	16506	8694
11	0	0	254	B	635	635	4727	16507	8695
12	0	0	255	B	635	635	4727	16507	8695
13	127	127	0	R+G	635	635	4727	16507	8695
14	127	1	0	R+G	634	634	4726	16506	8695

15	127	254	0	R+G	634	634	4727	16506	8695
16	127	255	0	R+G	635	635	4727	16507	8695
27	1	127	0	R+G	634	634	4726	16506	8695
18	254	127	0	R+G	635	635	4727	16507	8695
19	255	127	0	R+G	635	635	4727	16507	8695
20	127	0	1	R+B	634	634	4726	16506	8694
21	127	0	127	R+B	635	635	4727	16507	8694
22	127	0	254	R+B	635	635	4727	16507	8694
23	127	0	255	R+B	635	635	4727	16507	8694
24	1	0	127	R+B	634	634	4726	16506	8694
25	254	0	127	R+B	634	634	4727	16506	8694
26	255	0	127	R+B	634	634	4727	16506	8694
27	0	127	1	G+B	634	634	4726	16506	8694
28	0	127	127	G+B	634	634	4726	16506	8694
29	0	127	254	G+B	635	635	4727	16507	8694
30	0	127	255	G+B	635	635	4726	16507	8694
31	0	1	127	G+B	634	634	4726	16506	8694
32	0	254	127	G+B	634	634	4726	16506	8694
33	0	255	127	G+B	634	634	4727	16506	8694
34	127	127	1	R+G+B	633	633	4725	16505	8694
35	127	127	127	R+G+B	630	630	4722	16502	8694
36	127	127	254	R+G+B	633	633	4725	16505	8694
37	127	127	255	R+G+B	633	633	4725	16505	8694
38	1	127	127	R+G+B	634	634	4725	16506	8694
39	254	127	127	R+G+B	634	634	4722	16506	8694
40	255	127	127	R+G+B	634	634	4725	16506	8694
41	127	1	127	R+G+B	635	635	4726	16507	8694
42	127	254	127	R+G+B	635	635	4725	16507	8694
43	127	255	127	R+G+B	635	635	4722	16507	8694

Table 9: Illustration of images size (type: JPG) with different dimension

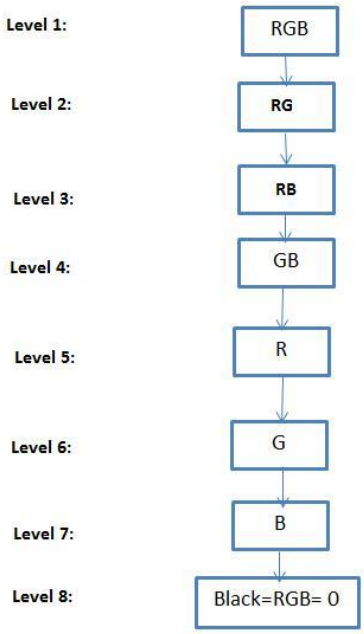

Figure 2: Level 1 represents an image with large size, size decreases when we move to the bottom.

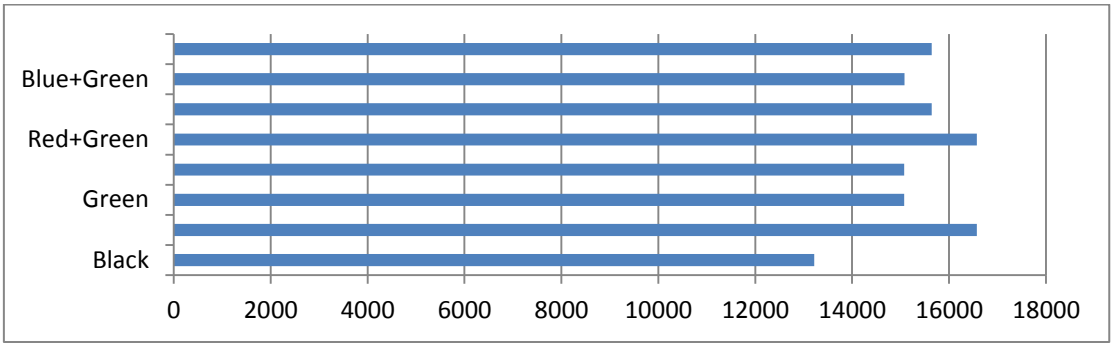

Figure 3: Showing size of all possible color combinations (0-255) with dimension 1000*1000 (PNG images) X-axis represents bytes, Y-axis represents colors

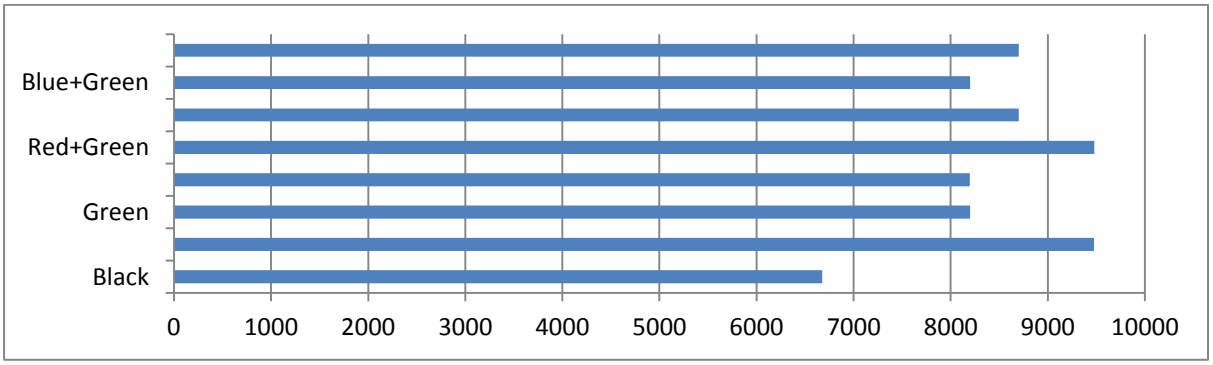

Figure 4: Showing size of all possible color combinations (0-255) with dimension 500*1000 (PNG images)
The x-axis represents bytes, Y-axis represents colors

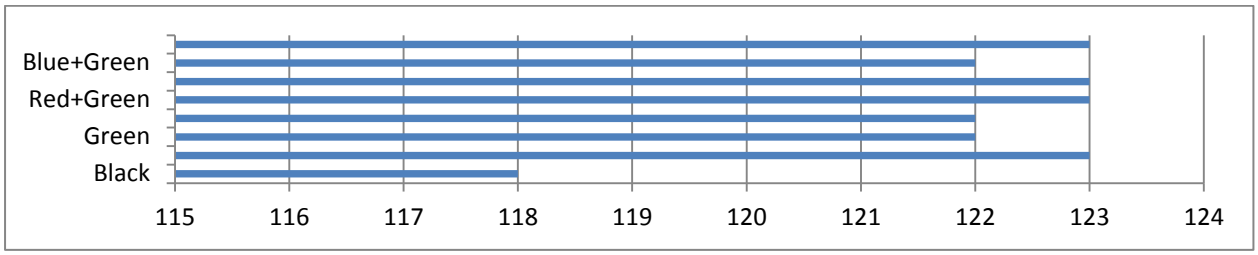

Figure 6: Showing size of all possible color combinations (0-255) with dimension 2*2 (PNG images) The x-axis represents bytes, Y-axis represents colors

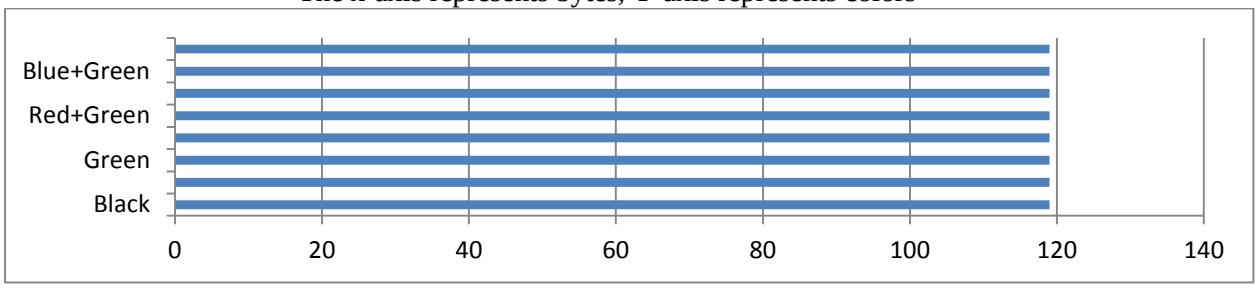

Figure 7: Showing size of all possible color combinations (0-255) with dimension 1*1 (PNG images) The x-axis represents bytes, Y-axis represents colors in JPG

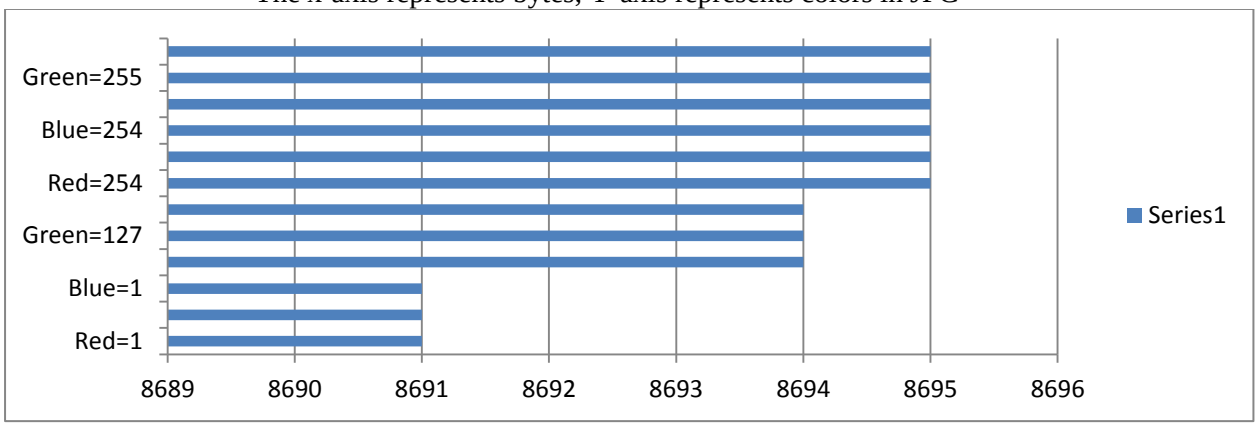

Figure 8: Showing size of all possible combinations of Red, Green and Blue color (0-255) with dimension 500*1000 (JPG images), X-axis represents bytes, Y-axis represents color values.

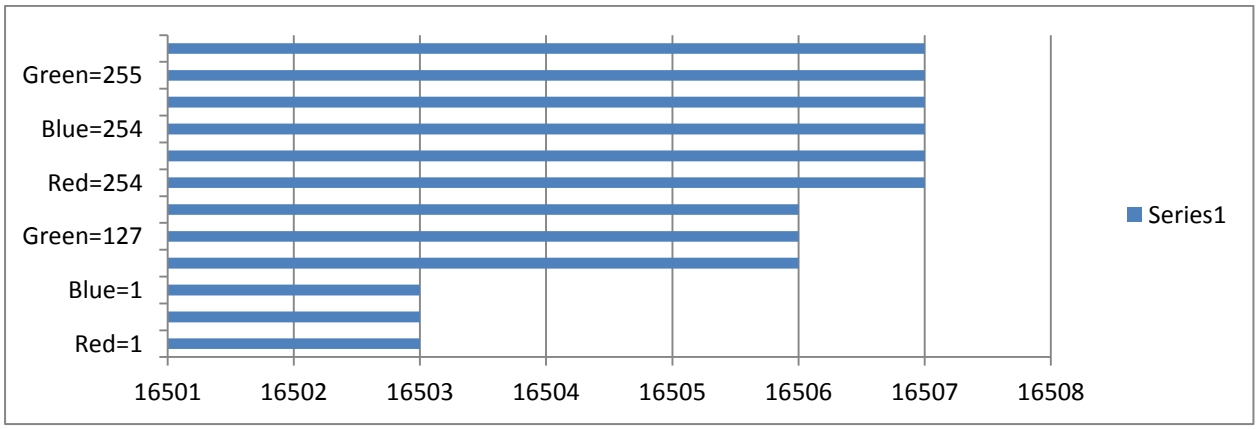

Figure 9: Showing size of all possible combinations of Red, Green and Blue color (0-255) with dimension 1000*1000 (JPG images), X-axis represents bytes, Y-axis represents color values.

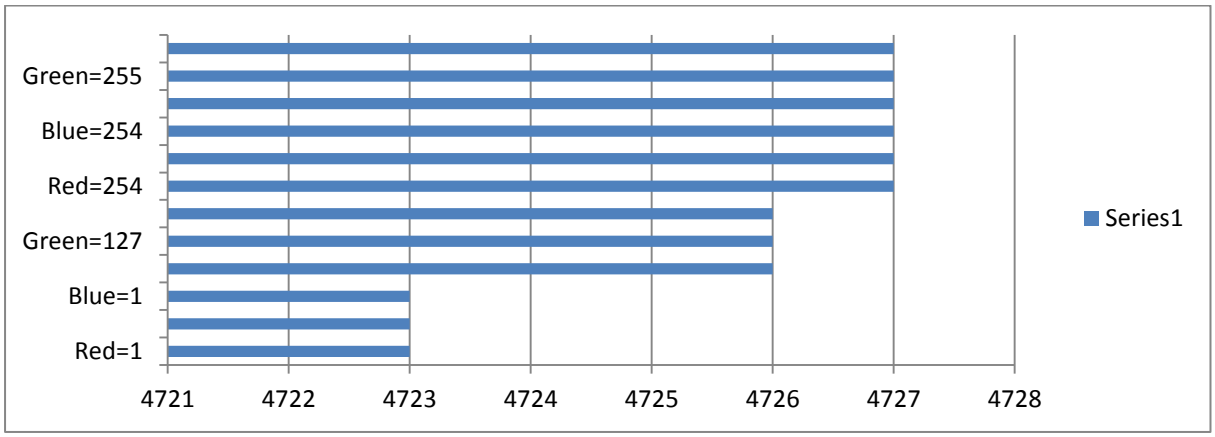

Figure 10: Showing size of all possible combinations of Red, Green and Blue color (0-255) with dimension 500*500 (JPG images), X-axis represents bytes, Y-axis represents color values.

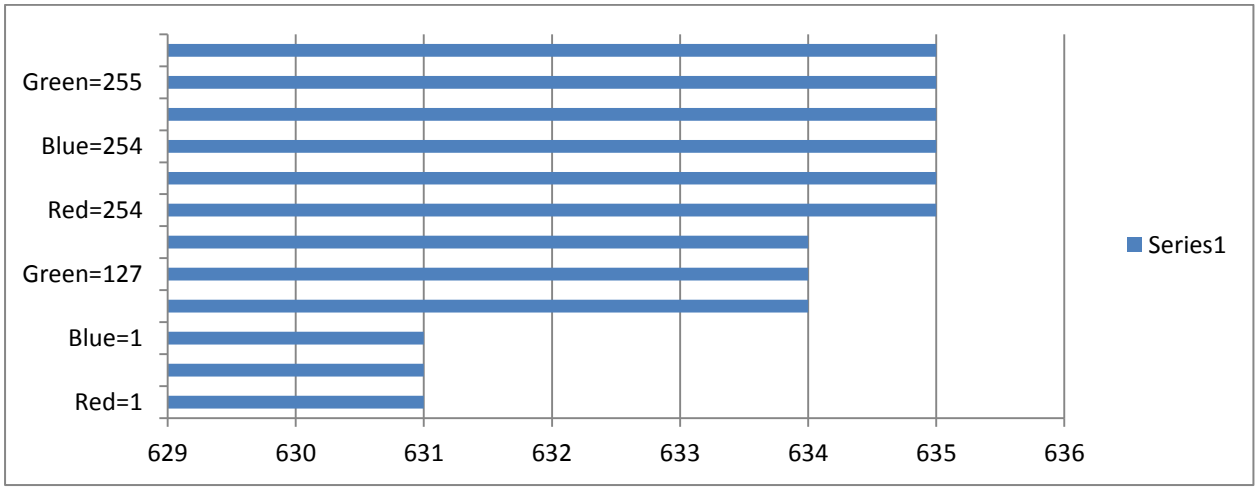

Figure 11: Showing size of all possible combinations of Red, Green and Blue color (0-255) with dimension 2*2 (JPG images)

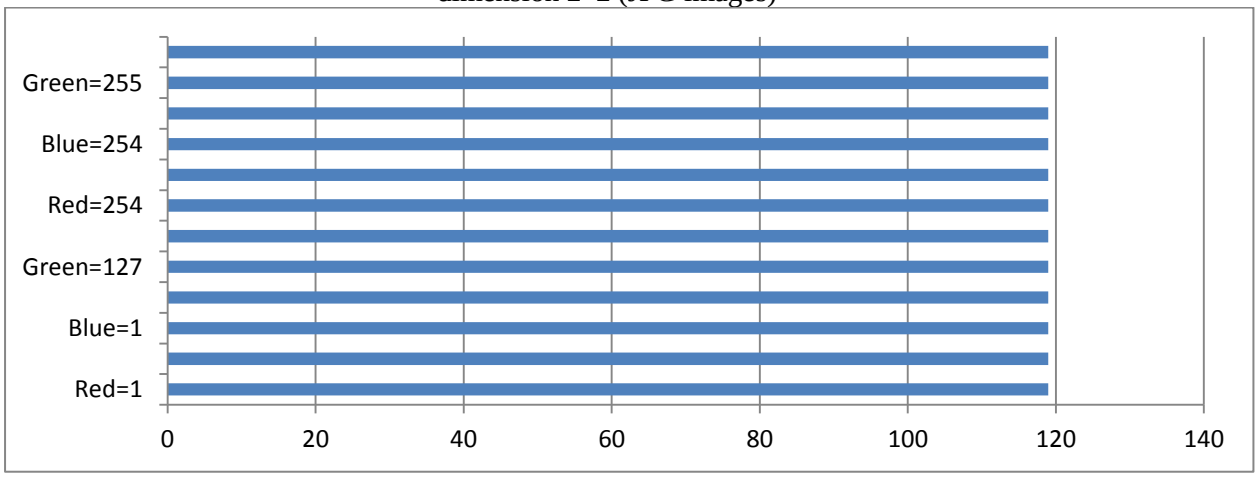

Figure 12: Showing size of all possible combinations of Red, Green and Blue color (0-255) with dimension 1*1 (JPG images), X-axis represents bytes, Y-axis represents color values.

5. RESULTS

During the experiments with single colored (0-255) PNG images, we get the following results as illustrated in Figure 2-7 and in Table 10, 11;

Red color (0-255) occupies more space as compared to Green (0-255). Red color with dimension 500 * 100 occupies 13.48528 % extra space, with dimension 1000 * 1000 occupies 9.02179% extra space, with dimaension500 * 500 occupies 13.27507% extra space, with dimension 2 *2 occupies 0.813008% extra space and same size on dimension 1 * 1.

Red color (0-255) occupies more space as compared to blue (0-255). Red color with dimension 500 * 1000 occupies 13.50638% extra space, with dimension 1000 * 1000 occupies 9.03385% extra space, with dimension 500 * 500 occupies 13.29588% extra space, with dimension 2 * 2 occupies 0.813008% extra space and same size on dimension 1 * 1.

Green color (0-255) occupies more space as compared to blue (0-255). Green color with dimension 500 * 1000 occupies 0.0243932% extra space, with dimension 1000 * 1000 occupies 0.01326612% extra space, with dimension 500 * 500 occupies 0.0239923% extra space and same size on dimension 2 * 2 and 1 * 1.

Red color (0-255) occupies more space as compared to black (0-0-0). Red color with dimension 500 * 1000 occupies 29.5663% extra space, with dimension 1000 * 1000 occupies 20.2462 extra space, with dimension 500 * 500 occupies 8.40616% extra space, with dimension 2 * 2 occupies 4.06504% more extra space and same size on dimension 1 * 1.

Green color (0-255) occupies more space as compared to black (0-0-0). Green color with dimension 500 * 1000 occupies 24.68594% extra space, with dimension 1000 * 1000 occupies 12.3375% extra space, with dimension 500 * 500 occupies 18.37812% extra space, with dimension 2 * 2 occupies 3.27869% more extra space and same size on dimension 1 * 1.

Blue color (0-255) occupies more space as compared to black (0-0-0). Blue color with dimension 500 * 1000 occupies 18.56777% extra space, with dimension 1000 * 1000 occupies 12.3375% extra space, with dimension 500 * 500 occupies 18.35853% extra space, with dimension 2 * 2 occupies 3.27869% more extra space and same size on dimension 1 * 1.

ID	Difference Between	Difference In Size in %	Less Preferred	More preferred	Dimension
1	Red, Green	13.48528	Red	Green	500*1000
2	Red, Green	9.02179	Red	Green	10000*1000
3	Red, Green	13.27507	Red	Green	500*500
4	Red, Green	0.813008	Red	Green	2*2
5	Red, Green	0.00	Null	Null	1*1
6	Red, Blue	13.50638	Red	Blue	500*1000
7	Red, Blue	9.03385	Red	Blue	1000*1000
8	Red, Blue	13.29588	Green	Blue	500*500
9	Red, Blue	0.813008	Green	Blue	2*2
10	Red, Blue	0.00	Null	Null	1*1
11	Green, Blue	0.0243932	Green	Blue	500*1000
12	Green, Blue	0.01326612	Green	Blue	1000*1000
13	Green, Blue	0.0239923	Green	Blue	500*500
14	Green, Blue	0.00	Null	Null	2*2
15	Green, Blue	0.00	Null	Null	1*1
16	Black, Blue	18.56777	Blue	Black	500 * 1000
17	Black, Blue	12.3375	Blue	Black	1000 * 1000
18	Black, Blue	18.35853	Blue	Black	500 * 500
19	Black, Blue	3.27869	Blue	Black	2 * 2

20	Black, Blue	0.00	Null	Null	1*1
21	Black, Green	24.68594	Green	Black	500 * 1000
22	Black, Green	12.3375	Green	Black	1000 * 1000
23	Black, Green	18.37812	Green	Black	500 * 500
24	Black, Green	3.27869	Green	Black	2 * 2
25	Black, Green	0.00	Null	Null	1*1
26	Black, Red	29.5663	Red	Black	500 * 1000
27	Black, Red	20.2462	Red	Black	1000 * 1000
28	Black, Red	8.40616	Red	Black	5000 * 500
29	Black, Red	4.06504	Red	Black	2 * 2
30	Black, Red	0.00	Null	Null	1 * 1

Table 10: Illustration of difference between single color with a single color

During the experiments with two coloreds (0-255, 0-255) PNG images, we get the following results as illustrated in Figure 2-7 and in Table 10,11;

Red with Green color (1-255, 1-255) occupies more space as compared to Red with Blue (1-255, 1-255). Red with Green color with dimension 500 * 100 occupies 8.20848 % extra space, with dimension 1000 * 1000 occupies 5.62394% extra space, with dimension 500 * 500 occupies 8.05243% extra space, with dimension 2 *2 and 1 * 1 occupies same space.

Green with Red color (1-255, 1-255) occupies more space as compared to Green with Blue color (1-255, 1-255). Green with Red color with dimension 500 * 100 occupies 13.48386% extra space, with dimension 1000 * 1000 occupies 9.02124% extra space, with dimension 500 * 500 occupies 13.25427% extra space, with dimension 2 *2 occupies 0.813008% extra space and occupies same space on dimension 1 * 1.

Blue with Red color (1-255, 1-255) occupies more space as compared to Blue with Green color (1-255, 1-255). Blue with Red color with dimension 500 * 100 occupies 5.74713% extra space, with dimension 1000 * 1000 occupies 3.599744% extra space, with dimension 500 * 500 occupies 5.65739%extra space, with dimension 2 *2 occupies 0.813008% extra space and occupies same space on dimension 1 * 1.

ID	Difference Between	Difference In Size in %	Less Preferred	More preferred	Dimension
1	Red + Green, Red + Blue	8.20848	Red +Green	Red + Blue	500*1000
2	Red + Green, Red + Blue	5.62394	Red +Green	Red + Blue	10000*1000
3	Red + Green, Red + Blue	8.05243	Red +Green	Red + Blue	500*500
4	Red + Green, Red + Blue	0.00	Null	Null	2*2
5	Red + Green, Red + Blue	0.00	Null	Null	1*1
6	Green + Blue , Green + Red	13.48386	Green + Red	Green + Blue	500*1000
7	Green + Blue , Green + Red	9.02124	Green + Red	Green + Blue	1000*1000
8	Green + Blue , Green + Red	13.25427	Green + Red	Green + Blue	500*500
9	Green + Blue , Green + Red	0.813008	Green + Red	Green + Blue	2*2
10	Green + Blue , Green + Red	0.00	Null	Null	1*1

11	Blue + Green , Blue + Red	5.74713	Blue + Red	Blue + Green	500*1000
12	Blue + Green , Blue + Red	3.599744	Blue + Red	Blue + Green	1000*1000
13	Blue + Green , Blue + Red	5.65739	Blue + Red	Blue + Green	500*500
14	Blue + Green , Blue + Red	0.813008	Blue + Red	Blue + Green	2*2
15	Blue + Green , Blue + Red	0.00	Null	Null	1*1

Table 11: Illustration of difference between two colors (1-255, 1-255) with two colors.

During the experiments with single color (0-255) JPG images, we get the following results as illustrated in Figure 8-12;

Red color with value 1-255 have different size

Green color with value 1-255 have different size

Blue color with value 1-255 have different size

Red, Green and Blue color have the same size.

CONCLUSIONS

Image size is a challenging problem especially for web and when we want to have big data. Different techniques are available to optimize the image. Our proposed research shows different behavior of different colors. We conclude that most colors have different size. Color is a factor that can affect the image size. In PNG images Blue have less size as compared to Green. Green has less size as compared to Red. Similarly Red with Blue has less size as compared to Red with Green. Green with Blue has less size as compared to Green with Red. Blue with Green has less size as compared to Blue with Red.

In PNG images, different colors have the same size.eg; Red, Green, and Blue have the same size but one color with values 1-255 have different size. e.g.; Red color with values 1-255 has different size against each value.

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