JPEG Based Compression Algorithm

Mazen Abuzaher, Jamil Al-Azzeh

***Abstract*— Lossy image compression algorithms provide us with very small image size with a slight loss of image quality due to compression. JPEG is one of the most popular lossy compressions, which compresses the original image to 1/10 of its original size [1]. In this work, we propose an enhancement based on JPEG compression. Our enhancement will provide us with approximately 55% smaller image compared to standard JPEG image.**

***Index Terms*— Image compression, lossy compression, JPEG, RGB..**

I. INTRODUCTION

There are two types of image compression [2, 3]: lossless and lossy. Lossless compression generates a smaller image than the original one. After decompressing we restore the original image without any data loss. On the other hand, in lossy compression we cannot recover the original image without some losses but the compressed image will be smaller size compared to lossless compression.

Since lossy compressions provide much higher compression ratio than lossless compression, it is widely used in web site and network transmissions. There are many lossy algorithms; one of them is JPEG which introduce small image size with acceptable data loss [4, 5].

Many studies and algorithms have been done to introduce a lossy compression algorithm that outperforms JPEG [6, 7]. However, all these algorithms have a convergent performance compared with JPEG. According to the comparison in [8] between files with deferent extensions, GIF, JPEG, PNG, RAW, and TIFF, JPEG introduces smallest file size with acceptable file quality.

II. JPEG STANDARD

In 1980s, research began to introduce a new image compression scheme that promised to outperform the traditional existing compression algorithms. By the late 1980s, a new hardware coprocessor card was added to desktop system (UNIX and Macintosh workstations) as an application for this new compression scheme [9].

The new cards were able to perform lossy compression on images at ratios of as much as 95 percent without visible loss of the image quality. According to this perfect compression ration some forces worked to start development of an international standard that would support this new compression scheme. The two standardization groups involved the CCITT and the ISO, worked rapidly to introduce standardization for the new scheme [9].

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The standards group created by these two organizations is the Joint Photographic Experts Group (JPEG). The JPEG standard was developed over several years, and is now considered as the leading format for lossy graphics compression [9].

Now a day the JPEG specification consists of several parts that support both lossless and lossy compression. The lossless compression produces good compression of images without the loss of any resolution. On the other hand, the JPEG lossy compression technique introduce superior compression ratio with acceptable quality [4, 9].

The three core steps of the JPEG lossy compression algorithm shown in the next figure.

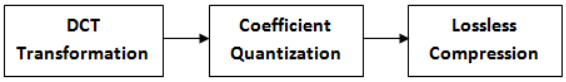

Figure 1: JPEG Core Steps

These three core steps combined with some additional processes introduce the standard JPEG compression. Next are the JPEG procession steps for color images [4, 10]:

- RGB to YCbCr color conversion.
- Divide the original image into 8x8 blocks.
- Modify the pixel values to fit in the range [-128 to 127] instead of [0 to 255].
- Apply DCT to each block.
- Quantization is performed to each block.
- Quantized matrix is entropy encoded.
- Reconstruct the compressed image using reverse process.

These steps form the powerful JPEG compression which reduces file size with minimum image degradation by eliminating the least important information. The output of JPEG is a lossy image compression where the final image and the original image are not completely the same in addition some information that may be lost [9, 10].

With JPEG user can choose a number between 100 and 1 to define the compression ratio. Where 100 introduces less compression with better image quality. In contrast 1 provides better compression with less image quality [10].

In this paper, we introduce JPEG based lossy algorithm. Our algorithm enhances the standard JPEG compression ratio to approximately 50%. Next section shows our algorithm in detail.

III. OUR ALGORITHM

To enhance standard JPEG compression ratio, we purpose an image pre-processing steps that increase color repetition

probability which in turn increases JPEG compression ration with very negligible loss of information. Figure 2 shows our compression steps.

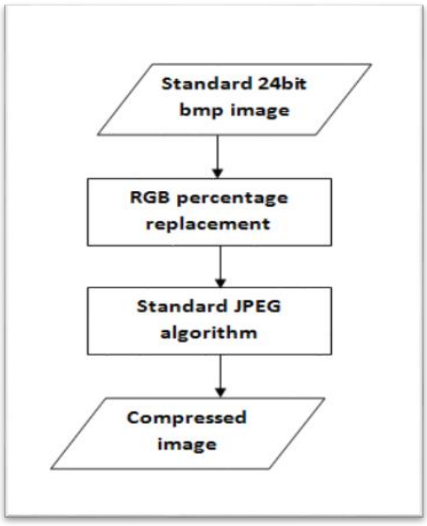

Figure 2: Compression steps

A. *Compression:*

In our compression algorithm (figure 2) we replace standard RGB value (0-255) with RGB percentage value (0-100) according to equations 1, 2, and 3:

$$R = \text{round}((R/255)*100). \quad (1)$$

$$G = \text{round}((G/255)*100). \quad (2)$$

$$B = \text{round}((B/255)*100). \quad (3)$$

RGB needs 24bits to represents any pixel, using 8bits for each Red, Green, and blue (8*3=24) which range from 0 to 255. Using percentage this rang will be reduced to be from 0 to 100, which mean that we need just 7bits to represent each color channel. Accordingly, before applying any compression we have reduced the image size about 13%. In addition, using percentage will increase repeated RGB values. Now applying standard JPEG compression to the percentage image provide us with a compressed image have smaller size than standard JPEG. As we will show in result section our compressed images are approximately 50% smaller than standard JPEG images with negligible effects.

Next figure shows our decompression steps:

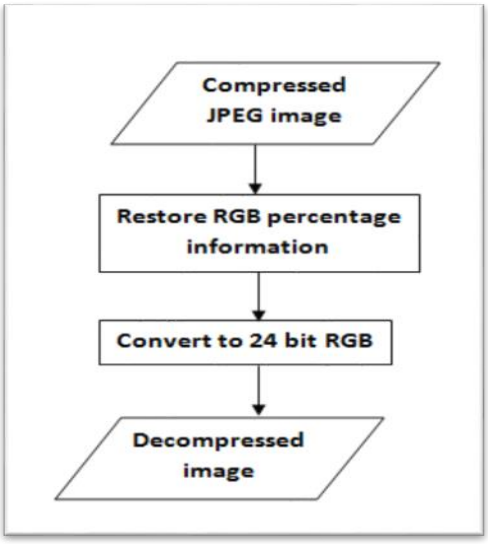

Figure 3: Decompression steps

B. *Decompression:*

As shown in figure 3, to restore RGB image, first we decompressed the image using standard JPEG. Applying equation 4, 5, and 6 will restore the original 24-bit RGB image.

$$R = \text{round}((R/100)*255). \quad (4)$$

$$G = \text{round}((G/100)*255). \quad (5)$$

$$B = \text{round}((B/100)*255). \quad (6)$$

IV. Results

Table 1 shows sample of our algorithm implementation in addition to compression ratio compared to standard JPEG. As a result, our algorithm output image approximately 50% smaller than standard JPEG image with acceptable quality.

Table 1: Experiments samples

Original 24-bit image	Standard JPEG	Our algorithm	Compression - ratio compared to JPEG
	 Size: 126K	 Size:49.9K	60%
	 Size: 127K	 Size: 53K	58%

V. Conclusion

In this paper, we introduced an image compression algorithm based on standard lossy compression JPEG. According to experiments our algorithm achieves compression up to 60% smaller than standard JPEG depending on the input image. Moreover, our algorithm preserves image quality with negligible effects.

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