Efficient and Fast Image Compression Using DCT Mask Coefficient Block Processing

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Abstract - Data compression, in a perfect world with no error or with a moderately low error, is attractive to save memory storage requirements and time taken for data transmission. The above mentioned requirements are more significant in the case of image data. The data redundancies require large storage space. The compression can be obtained by minimizing these redundant data is known as data compression. Mathematically data compression implies procedure of transforming array of image pixel into statistically uncorrelated data set. Basically in image compression schemes, spectral and spatial redundancy should be reduces as much as possible. In this work, the images are compressed by using DCT Mask Coefficient Block Processing. The compression is achieved by reducing the spatial redundancy of the image/frame data. The simulation has done on Matlab and the performance has been evaluated based on the PSNR calculation and compression ratio.

Keywords- Image Compression, PSNR, DCT, DWT, Loss less coding, Lossy Coding, Data Compression.

I. INTRODUCTION

Exchange of information is a means of knowledge sharing which is vital for the progress of mankind. The technological advancements in digital communication and computer technology have paved the way for all pervading World Wide Web based internet. The development and deployment of 4G technology based mobile communication has provided a powerful multimedia communication device for users. The multimedia signals are alphanumerical text signals, audio signals including speech and music, and video signals including still and moving images. Transducer based sensor data may fall under any one or more of the above categories of signals, ie, text, audio and video. Sensor networks have emerged as an integral part of information technology.

Study has shown that the 90% of total volume of data in internet access consists of image and video related data [1]. Image and video in their raw (uncompressed) form requires huge storage space. Such raw data needs large transmission bandwidth for the transmission over the network. Hence, lots of researches have been conducted in the field of data compression system. However, in this present day web age, the interest for data transmission and the data storage are expanding. In this worry, data compression and remaking is the main alternative to alleviate the system clog. The compression method decreases the measure of data, which thusly requires less bandwidth and less transmission time and related cost. There are algorithms developed for the data compression such as: Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT), Walsh Hadamard Transform (WHT), etc.

Although data compression is useful to improve the performance of network and storage technologies, one might wonder if it is really worth the use of compression techniques due to the capacity improvements in storage devices (such as DVD disks and larger and larger hard drives) and transmission lines (due to the use of optical fiber lines and xDSL technology). The answer to this question is yes, because as both technologies improve their performance, their demand is increasing a lot; mainly in multimedia networks and applications, which need a large amount of memory to represent multimedia data. Thus, the use of compression techniques allows us to take advantage of the available resources in a better way, achieving better performance at lower cost. For example, a regular audio CD is able to store about 15¬20 songs that are "raw coded" (uncompressed) to simplify the hardware design of stand-alone players. However, if we use a software player, audio compression can be introduced provided that the computer running the software is able to decompress it in real time. This way, hundred of songs can be stored on the same CD with the same perceptual audio quality. As time went by, when a hardware design for audio decompression is feasible at relatively low cost, new hardware players with decompression support can be introduced.

Hence, there is a trade-off between the benefits of data compression and some drawbacks that it introduces, such as higher latency and increase in memory and hardware requirements. Each system designer should evaluate if compression is necessary, and determine the impact of compression on the system to decide if it can be accepted.

A data compression framework principally comprises of three noteworthy strides and that are expulsion or lessening in data excess, decrease in entropy, and entropy encoding. A commonplace data compression framework can be marked utilizing the square graph appeared in

Figure 1.1 It is performed in steps, for example, image transformation, quantization and entropy coding. JPEG is a standout amongst the most utilized image compression standard which utilizes discrete cosine transform (DCT) to transform the image from spatial to frequency domain [2]. An image contains low visual information in its high frequencies for which heavy quantization can be done in order to reduce the size in the transformed representation. Entropy coding follows to further reduce the redundancy in the transformed and quantized image data.

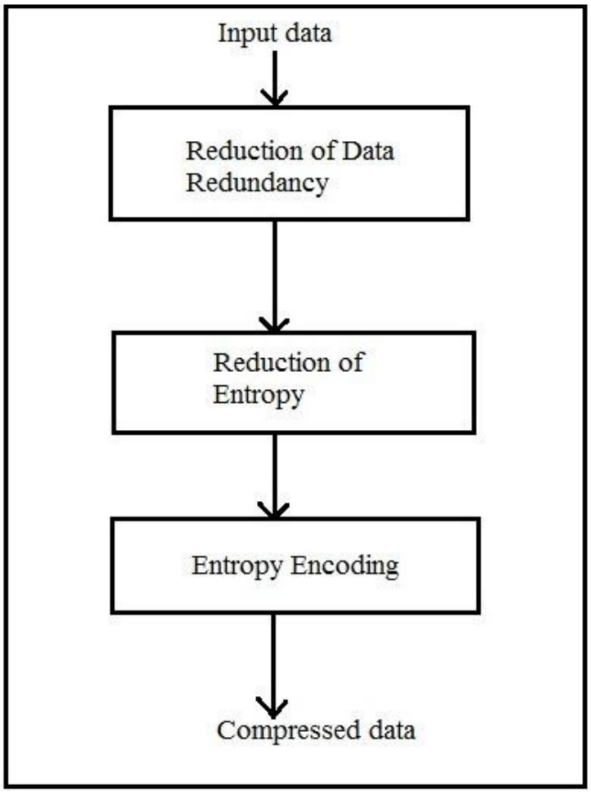


Figure 1.1 A data Compression model.

II. IMAGE COMPRESSION PRINCIPLE

Image compression is the utilization of data compression and is an arrangement of reducing the redundancies in image and represents it in shorter way. Image compression can be lossy or lossless. There are both lossy and moreover lossless compression schemes. Depending upon the requirement we chose different techniques. For high value images, for example, medical images where loss of basic data is not satisfactory, lossless or outwardly lossless compression is preferred.

JPEG is an extremely well known ISO/ITU-T standard that was made in the late 1980s. Lossless JPEG is one of the few JPEG standards.In lossless mode, the image is transformed by differential heartbeat code regulation (DPCM), and then Huffman is applied for encoding. DPCM depends on anticipating the image pixels from the neigh-exhausting pixel by a particular condition and figuring the error of forecast.

JPEG-LS standard of coding still images gives lossless and close lossless compression. The baseline framework or the lossless scheme is accomplished by versatile expectation, setting displaying, and Golomb coding.

JPEG2000 depends on the discrete wavelet transform (DWT), scalar quantization, setting demonstrating, arithmetic coding, and post-compression rate distribution. JPEG2000 works well furthermore, gives a decent compression proportion particularly for high-detail images, since it breaks down the subtle elements and the estimation in the transformation step and decorrelates them. However, JPEG2000 has high computational complexity.

Images have extensively higher storage necessity than content; Audio and Video Data require all the more requesting properties for data storage. An image put away in an uncompressed record organize, for example, the famous BMP arrange, can be gigantic. An image with a pixel assurance of 640 by 480 pixels and 24-bit color determination will take up 640 * 480 * 24/8 = 921,600 bytes in an uncompressed design.

The tremendous measure of storage space is the thought as well as the data transmission rates for communication of constant media is likewise significantly substantial. An image, 1024 pixel x 1024 pixel x 24 bit, without compression, would require 3 MB of storage and 7 minutes for transmission, utilizing a fast, 64 Kbits /s, ISDN line.

Image data compression turns out to be still more essential in view of the way that the transfer of uncompressed graphical data requires much more bandwidth and rate of data transfer. For instance, throughput in a mixed media framework can be as high as 140 Mbits/s, which must be exchanged between frameworks. This kind of data transfer rate is not realizable with today's technology, or in near the future with reasonably priced hardware.

A. Image Compression Techniques

There are basically two methods of Image Compression:

1. Lossless Coding Techniques

2. Lossy Coding Techniques

- Lossless Coding Techniques:

In Lossless Compression schemes, the reconstructed image, after compression, is numerically indistinct to the main image. However Lossless Compression can finish an unassuming measure of Compression.

Lossless coding ensures that the decompressed image is completely indistinguishable to the image before compression. This is an essential prerequisite for some application domains, e.g. Medical Imaging, where high caliber is in the request, as well as unaltered filing is a lawful prerequisite. Lossless systems can likewise be utilized for the compression of other data sorts where loss of data is not worthy, e.g. content reports and program executables. Lossless compression algorithms can be utilized to crush down images and afterward reestablish them again to view totally unchanged.

Lossless Coding Techniques are as follows: Source Encoder Input Image F(x, y)

1. Run Length Encoding
2. Huffman Encoding
3. Entropy Encoding
4. Area Encoding

- Lossy Coding Techniques:

Lossy techniques cause image quality debasement in every Compression/De-compression step. Watchful thought of the Human Visual discernment guarantees that the corruption is frequently unrecognizable, however this relies upon the chose compression proportion. An image remade following Lossy compression contains debasement with respect to the first. Often this is on the grounds that the compression schemes are fit for accomplishing considerably higher compression. Under typical survey conditions, no noticeable loss is seen (visually Lossless).

A typical lossy image compression system shown in figure 2.1, consist of three closely connected components: (a) Source Encoder or Linear Transforms (b) Quantizer and (c) Entropy Encoder.

A Quantizer just diminishes the quantity of bits expected to store the transformed coefficients by lessening the exactness of those values. Since this is a many-to-one mapping, it's a lossy procedure and is the principle wellspring of compression in an encoder. Quantization can be performed on each individual coefficient, which is known as Scalar Quantization (SQ). Quantization can in like manner be performed on a get-together of coefficients together, and this is known as Vector Quantization (VQ). Both, uniform and non-uniform quantizer can be utilized relying upon issue close by.

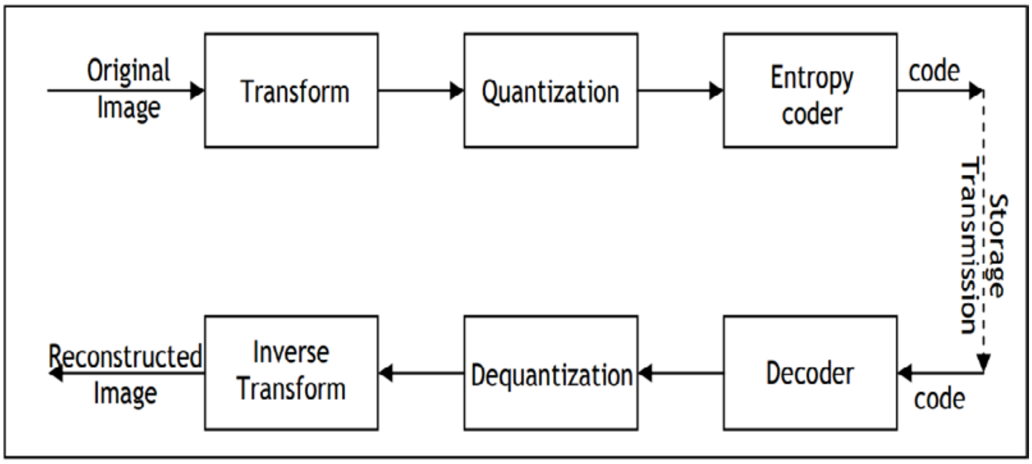


Figure 2.1 Typical Image Coder block representation.

An Entropy Encoder additionally packs the quantized values losslessly to give better general compression. Most generally utilized entropy encoders are the Huffman encoder and the Arithmetic encoder, despite the fact that for applications requiring quick execution, straightforward run-length coding has demonstrated extremely viable. A appropriately planned quantizer and entropy are totally essential alongside ideal signal transformation to get most ideal compression.

Over the years a variety of linear transforms have been developed which include Discrete Fourier Transform (DFT),Discrete Cosine Transform (DCT), Discrete Wavelet Transform (DWT) and many more, each with its own advantages and disadvantages.

The Discrete Cosine Transform is one of many transforms that takes the info and transforms it into a direct mix of weighted premise capacities. These premise capacities are regularly the frequency, similar to sine waves. The 2D Discrete Cosine Transform is just a one dimensional DCT applied twice, once in the x direction, and the second in the y direction.

III. PROPOSED WORK

The proposed work is based on DCT as demonstrated in figure 3.1. The discrete cosine transform (DCT) helps separate the image into parts (or spectral sub-bands) of differing importance (with respect to the image's visual quality). The DCT is similar to the discrete Fourier transform: it transforms a signal or image from the spatial domain to the frequency domain.

In the proposed work as illustrated in figure 3.1 block diagram image is loaded in Matlab environment to process compression experiment. calculate the size of image and pass it through block processing where image has converted in 16X16 DCT matrix and pass image t o second block associated with coefficient matrix . finally process image for reverse block processing we will have a compressed image calculate the size of this compresses image. then calculate PSNR of the compressed image. Percentage of compression and time taken to process image compression algorithm. now the complete image of compresses form has obtained. the flow of process has given in figure 3.2.

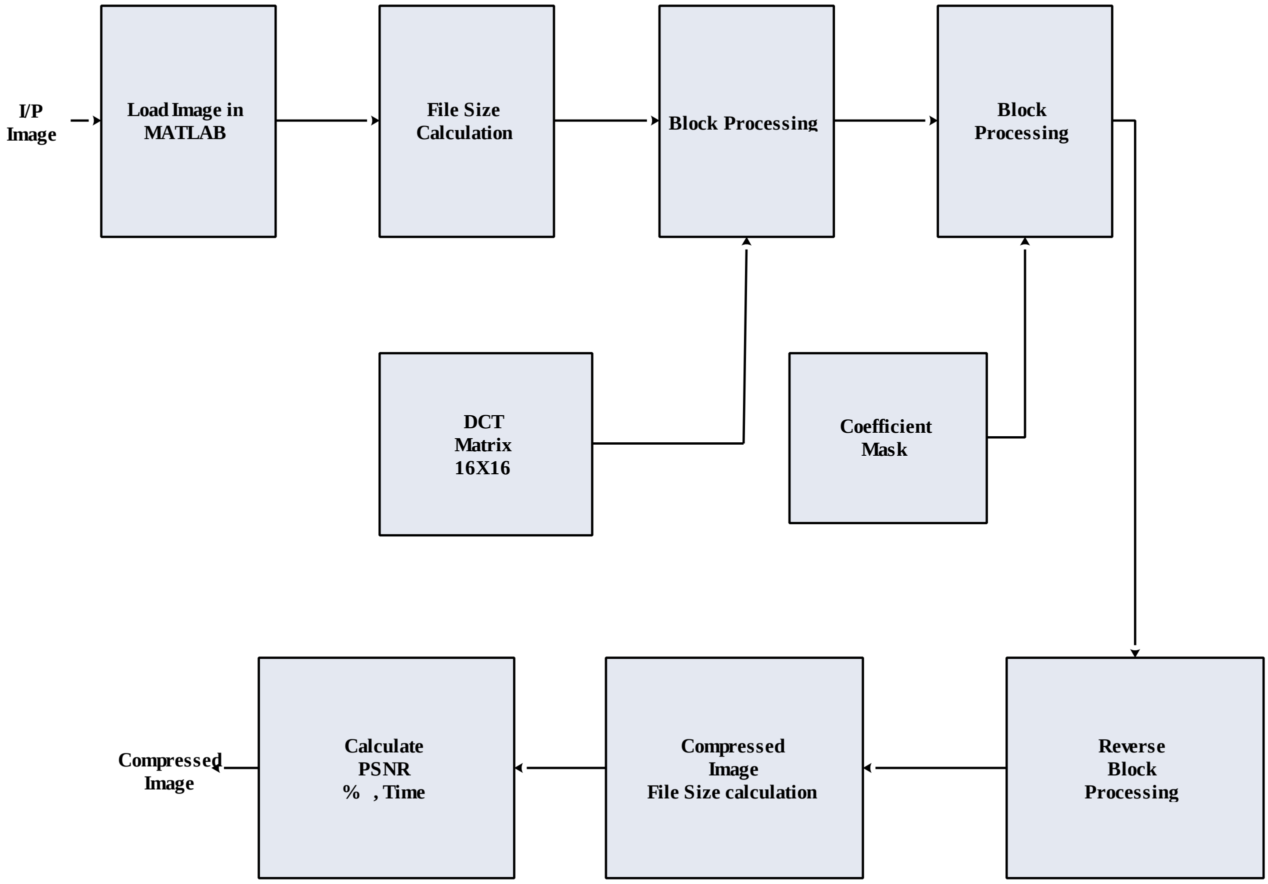


Figure 3.1 Block Diagram of proposed work.

A. Steps of Simulation

1. Browse Test Image

2. Load Image into Matlab Environment

3. Calculate File size of input image

4. Convert Image in to Data type Double.

5. Generate matrix of 16X16

6. Create Mask with Different Length of coefficient

7. Block Process image with DCT matrix

8. Block Process DCT image with mask

9. Reverse block process to get compressed image

10. Save compresses mage and calculate PSNR , Compression time percentage of compression

11. Display result of compressed image

IV. SIMULATION RESULT DISCUSSION

Implementation and simulation of proposed image compression has done on Matlab 13.1. IDE outcome of proposed work has given in figure 4.1 and figure 4.2. images shown in figure 4.1 and 4.2 are taken from the base paper work. which are compressed in proposed work. compressed ratio of the proposed work has batter then the base work the comparison of performance of proposed work has done in table 4.1 with respect to PSNR and compression ratio. In figure 4.1 (a) left has side Barbara original image and figure 4.1 (b) compressed image of Barbara by proposed work and figure 4.2 Bust Original Image and compressed image are displayed in 4.2 (a) and figure 4.2(b) respectively.

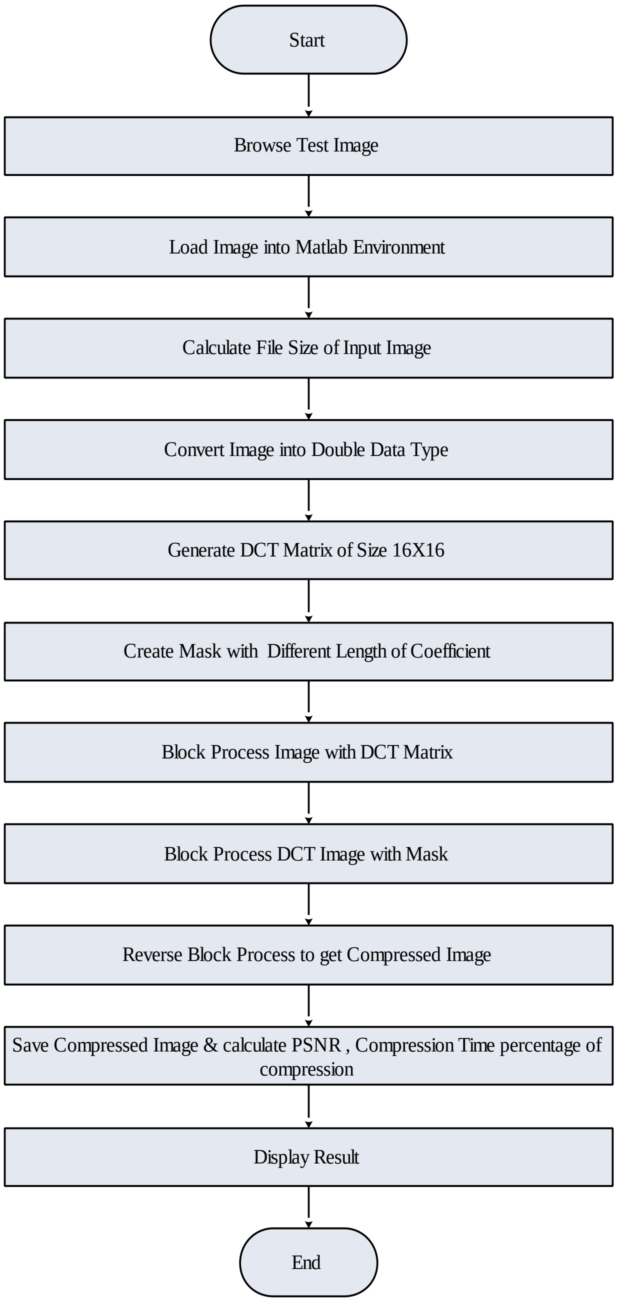


Figure 3.2 Process flow of proposed work.

Table 4.1 Comparison of PSNR with Previous Work

Image	***Previous Method (IWT+DCT)***	***Proposed Method (DCT Coefficient Based Block Processing)***	***Improvement***
Barbara	29.7	34.99	17.81 %
Bust	30.7	37.974	23.69 %

Table 4.2 Compression Computation Time

Image	***Proposed Method (DCT Coefficient Based Block Processing)***
Barbara	0.157 seconds
Bust	0.152 seconds

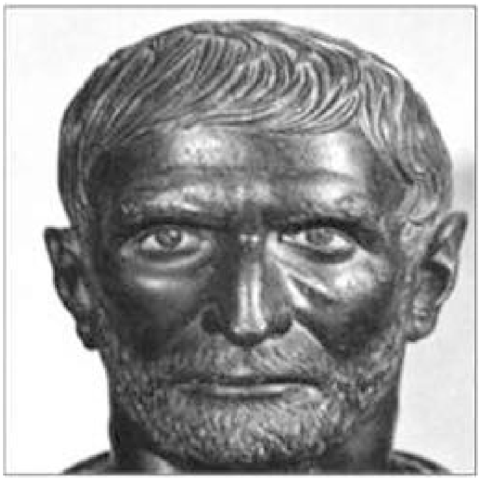
Table 4.3 Compression Computation Time

Image	***Proposed Method (DCT Coefficient Based Block Processing)***
Barbara	0.157 seconds
Bust	0.152 seconds

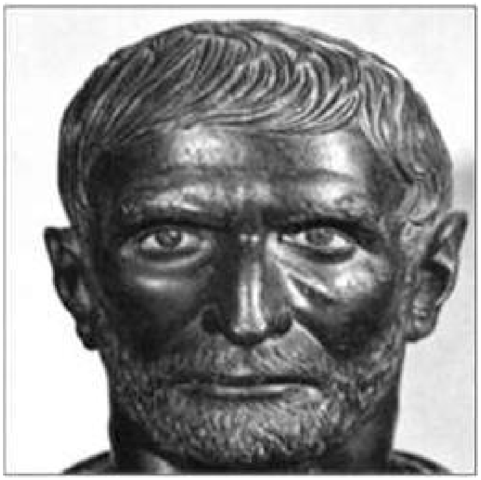
(a)

(b)

Figure 4.1 (a) Barbara Original Image of Size 256x256 (b) Compressed Image.



(a)



(b)

Figure 4.2 (a) Bust Original Image of Size 256x256 (b) Compressed Image

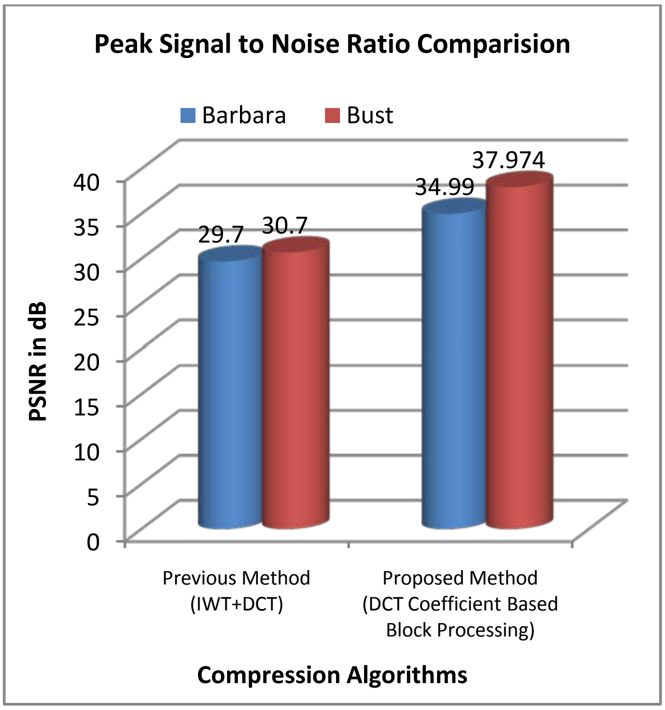


Figure 4.3 Graphical Comparison of Different Images

V. CONCLUSION

This work we have proposed a method to reduce complexity and memory usage for wavelet coding. Although great efforts have been made to improve compression efficiency and allow additional features, although complexity reduction may seem of limited interest in high-performance workstations with plenty of memory, some particular applications, like image editing for large images and especially GIS applications, cannot be easily tackled with the complexity of previous encoders. In addition, many other common applications, like simple slide show, become annoying if the decoding delay is too high. In this work two images from base paper Barbara Original Image and Bust Original Image are taken as experimental test image and compresses in Matlab environment. the outcome with respect to PSNR are calculated an compared with base work.

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