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RASTER LINE COMPRESSION DIFFERENCE HUFFMAN CODING TECHNIQUE

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Abstract:
"A complex idea can be conveyed in just single still image". Storage and transmission of digital image has become more of a necessity than luxury these days, hence the importance of Image compression. Image data files commonly contain considerable amount of information that is redundant and irrelevant leading to more disk space for storage. Image compression] is minimizing the size in bytes of an image file without degrading the quality of the image to an unacceptable level. During a step called quantization, where part of compression[5] occurs, the less frequencies are discarded. This paper represent the lossless image compression on still image, which is based on Hashing and Huffman Coding technique to show the better compression.

Key words: Image compression, Hashing, Huffman Coding,Frequency Table, Encoder, Decoder, Quantizer

1. Introduction

Image compression is technique of reducing the size, eliminating redundant or unnecessary information which is present in an image file. The compression techniques exploit inherent redundancy [4] and irrelevancy by transforming the image file into a smaller size, from which the original image file can be reconstructed exactly or approximately. The reduction in file size saves the memory space and allows faster transmission of images over a medium. It also reduces the time required for images to be sent over the Internet or downloaded from web pages.

1.1. Data Redundancy:

A commonly image contain redundant information i.e. because of neighboring pixels which are correlated and contain redundant information. The main objective of image compression [5,7] is redundancy] and irrelevancy reduction. It needs to represent an image by removing redundancies as much as possible, while keeping the resolution and visual quality of compressed image as close to the original image. Decompression is the inverse processes of compression i.e. get back the original image from compressed image. Compression ratio is defined as the ratio of information units an original image and compressed image which is shown in Fig 1

Compression

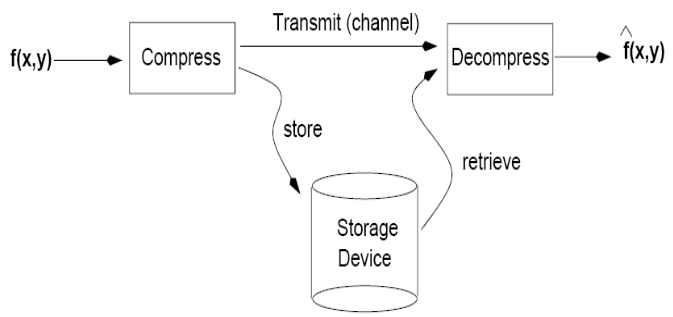

Figure 1 Data Redundancy

Let n1 and n2 denote the number of information carrying units in two data sets that represent the same information. The relative redundancy RD is defined as: $RD = 1 - 1/CR$
Where CR commonly called the compression ratio[1],
is $\quad CR = n1/n2$

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If $n1 = n2$, $CR=1$ and $RD = 0^{n2}$ *no redundancy*
If $n1 >> n2$, $CR >>1$ and $RD >>0$ *high redundancy*
If $n1 << n2$, $CR<<1$ and $RD <<0$ *undesirable*

A compression ratio of 10 (10:1) means that the first data set has 10 information carrying units (say, bits) for every 1 unit in the second (compressed) data set. In image compression [8] three basic redundancies can be identified: Coding Redundancy, Interpixel Redundancy and Psychovisual Redundancy. In Coding redundancy some gray levels are more common than others. The gray levels with more frequency can be given code of smaller length to reduce the overall space. e.g. Huffman Coding]. In Inter-pixel redundancy, the value of any given pixel can be reasonably predicted from the value of its neighbors. The information carried by individual pixels is relatively small. This is also spatial redundancy, geometric redundancy or interframe redundancy e.g. Differential Coding, Run Length coding. In Psycho-visual Redundancy, as the human eye does not perceive all the details, less relative information is eliminated. The eye does not respond equally to all visual information. Information of less relative importance is psychovisually redundant. It can be eliminated without significantly impairing visual"quality". The elimination of psycho-visually redundant data results in loss of quantitative information; it is commonly referred as quantization. The. All the inner squares have the same intensity but the progressively look darker as the background becomes lighter.

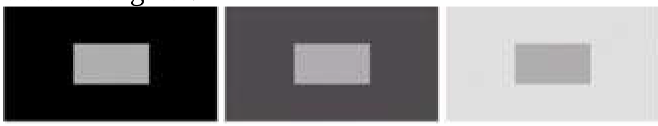

Fig 2: Simultaneous contrast .All the inner squares have the same intensity. But they appear progressively darker as the background becomes higher.

1.1. Image compression and Decompression

The image compression] system is composed of two distinct functional components: encoder and decoder Fig. 3. Encoder performs compression while Decoder performs decompression [7]. Both operations can be performed in software, as in case of Web browsers and many commercial image editing programs, or in a combination of hardware and firmware, as in DVD players. A codec is a device which performs coding and decoding. Input image f(x…) is fed into the encoder, which creates a compressed representation of input. It is stored for later use or transmitted for storage and use at a remote location. When the compressed image is given to decoder (Fig 3), is constructed output image f"(x...) is generated. In still image applications, the encoded input and decoder output are f(x,y)& f"(x,y) respectively. In video applications, they are f(x, y, t) & f"(x, y, t) where "t" is time. If both functions are equal then the system is called lossless and error free, lossy otherwise.

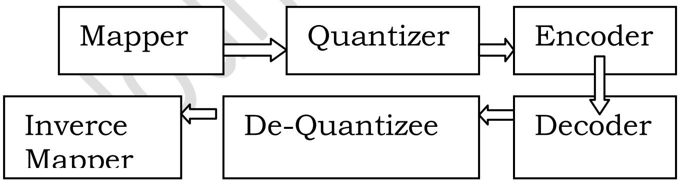

Figure 3 Block Diagram for Image compression

Encoding Process

Encoder is used to remove the redundancies through a series of three independent operations.

***Mapper*:**

It transforms f(x…) into a format designed to reduce spatial and temporal redundancies. It is reversible. It may /may not reduce the amount of data to represent image. E.g. Run length coding. In video applications, mapper uses previous frames to remove temporal redundancies.

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***Quantizer* :**

It keeps irrelevant information out of compressed representations. This operation is irreversible. It must be omitted whenever error free compression is desired. In video applications, bit rate of encoded output is often measured and used to adjust the operation of the quantizer so that a predetermined average output is maintained. The visual quality of the output can vary from frame to frame as a function of image content.

***Symbol Encoder*:**

Generates a fixed or variable length code to represent the quantizer [9] output and maps the output in accordance with the code. Shortest code words are assigned to the most frequently occurring quantizer output values, thus minimizing codingredundancy[2]. It is reversible. Upon its completion, the input image has been processed for the removal of all three redundancies. Decoder or Decoding Process Quantization results in irreversible loss, an inverse quantizer block is not included in the decoder block.

1.3 Importance of Image Compression

The importance of image compression increases with advancing communication technology.

Limited hardware and resources is also important in sending of datafield.The number of images compressed and decompressed daily is innumerable. Raw image can occupy a large amount of memory both in RAM and in storage. Compression reduces[2]the storage space required by an Image[6] and the bandwidth needed while streaming that image across a network. Image compression is important for web designers who want to create faster loading webpage‟s which in turn make website more accessible to others. In a medical field, image compression plays a key role as hospitals move towards filmless imaging and go completely digital. There are many applications which require image compression, such as multimedia, internet, satellite imaging, remote sensing etc.

1.4 Types of Compression: They are two types of image compression [7][3] algorithm: lossy and lossless

1.4.1 Lossy Compression

In this technique, size of an image is reduced, with loss of some data or information. The compressed image is similar to the original image but not identical. Lossy compression reduces file size by eliminating certain information, especially redundant information. When a file is decompressed[6], only part of the original information is present (but user may not notice it).Lossy compression is commonly used for photo graphs (JPEG-Joint Photographic Expert Group) and other complex still images on the web.

1.4.2 Lossless compression

In this technique, size of an image is reduced, without loss of any data or information. The compressed image is same as original image. With lossless compression, every single bit of data that was originally in the file, remains after the file is decompressed. All of the information is completely restored[9]. Lossless compression is commonly used for GIF (Graphics Interchange Format) file.

2. Huffman Coding

It was developed by David A. Huffman while he was a PhD student at MIT. It was published in 1952 in the paper "A method for construction of minimum redundancy Codes" [3]. Huffman coding[5] is an entropy encoding algorithm which is used for lossless data compression to remove the redundancies. The term refers to the use of a variable length code table for encoding a source symbol (such as a characters in file) where the variable length code table has been derived in a particular way based on estimated probability of occurrence for each possible value of source symbol. It is based on the frequency of occurrence of a data item i.e. pixels in an image. It yields smallest possible code symbol per source symbol.

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2.1 Algorithm

The Huffman’s approach is has two passes :

a. Most frequently occurring symbols will have shorter code words than symbols that occur less frequently. Create the series of reductions by ordering the probabilities.

b. The two symbols that occur least frequently will have the same length. Combine these lowest two probabilities. Sort the probabilities in descending order and repeat these steps till we get two probabilities.

3. Raster Line Difference Huffman Coding Technique

The compression model for Raster Line Difference Huffman(RLDH) Technique is as shown in Figure 4.

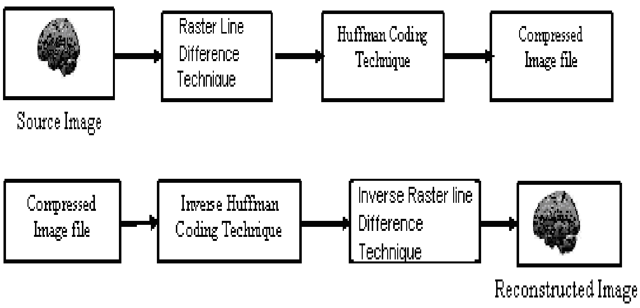

Figure 4: Raster Line Difference Huffman ICTM Model

7A	69	69	69	77	85	70	69
69	69	69	B2	B2	B3	B5	AE
65	65	DF	7A	7A	75	89	89
91	94	B2	B2	C6	25	95	06
69	7A	77	B2	DF	DF	69	69
95	95	65	65	69	69	7A	69
7A	7C	29	2B	24	25	89	8F
88	B2	AE	B3	AC	69	69	69

The Bit-Plane and Data-Tables generated, Anter applying the RLDH Image Coding Techniques are as shown in Figure 5 & Figure 6.

CF	**17**	**BE**	**EF**	**FA**	**AB**	**FF**	**FD**

Figure 5: Bit Plane

The data generated after consolidate Bit-Plane and Data-Table and adding header information is as shown in Figure 7

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00	00	08	← Header Information				
DF	17	BE	EF	FA	AB	FF	FD
7E	78	79	87	70	78	B1	B4
B5	AF	67	DF	7E	7B	80	90
91	96	B1	C6	23	97	04	78
7B	79	B1	DF	78	97	67	78
7B	76	7E	7C	28	2B	26	23
90	8F	92	B1	AF	B3	AE	78

Figure 6: Merged Contents

The Huffman table generated for the merged data given in Figure 6 is as shown in the Table.1

Byte	Count	Probability	Huffman Code
78	6	0.101694915	110
B1	4	0.06779661	1000
7B	3	0.050847458	1011
7E	3	0.050847458	1110
DF	3	0.050847458	11111
00	2	0.033898305	10100
23	2	0.033898305	10101
67	2	0.033898305	01010
79	2	0.033898305	01011
90	2	0.033898305	01000
97	2	0.033898305	01001
AF	2	0.033898305	01110
04	1	0.016949153	100110
08	1	0.016949153	100111
17	1	0.016949153	100100
26	1	0.016949153	100101
28	1	0.016949153	001010
2B	1	0.016949153	001011
70	1	0.016949153	001000
76	1	0.016949153	001001
7C	1	0.016949153	001110
80	1	0.016949153	001111
87	1	0.016949153	001100
8F	1	0.016949153	001101
91	1	0.016949153	000010
92	1	0.016949153	000011
96	1	0.016949153	000000

Table 1: Huffman Code Table for Raster line Difference

Huffman Image Coding Technique The final form of compressed contents without the Look-Up table is as shown in the Figure 7

A5	27	EC	B3	08	D0	20	AE
57	F5	9E	80	C0	86	EA	99
B5	AE	3F	25	5A	C9	E3	8A
2E	5A	AO	DO	E1	C3	8D	BE
46	98	64	17	DC			

Figure 7: Compressed File

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The brain image is abducted as exemplar source image, its histogram and statistical information are as shown in the Figure 8. The histogram gives the dissemination of the pixels ranges from 0-255.

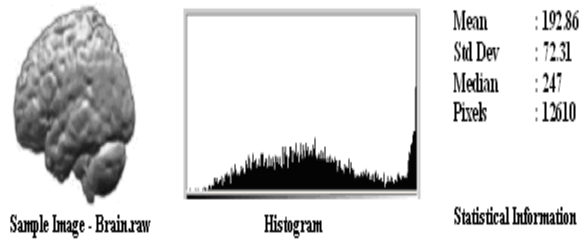

Figure 8 . Histogram and Statistical information for sample image Brain.raw

The JPEG image produced for the sample brain image, its histogram and statistical information are as shown in Figure 9

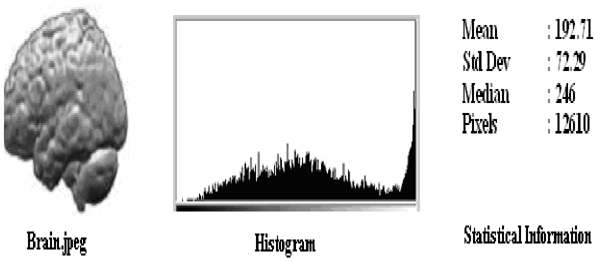

Figure.9. Histogram and Statistical information for the image Brain.jpeg

The quality of the JPEG image is checked by finding the diversity between the master source raw image and JPEG image. The difference image pixels are as shown the Figure 10. The different spots that are found in Figure 10 indicates that JPEG could not reproduce the original image as it is.

Fig.10. The Difference image between **raw** and **JPEG** image (zoom %1600)

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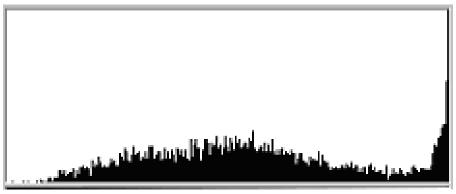
The reconstructed image using RLDH Image Coding Technique , its histogram and statistical information are as shown in the Figure

Reconstructed raw image



Histogram

Mean	:	192.86
Std Dev	:	72.31
Median	:	247
Pixels	:	12610

Statistical Information

Figure.11. Histogram and Statistical information for reconstructed image Brain.raw

The difference image generated between raw and reconstructed image is shown in Figure 12. The Figure is blank which clearly indicates that Raster line Difference Huffman Coding Technique has reconstructed the image to 100%. Hence this technique very much suitable for medical diagnosis of images.

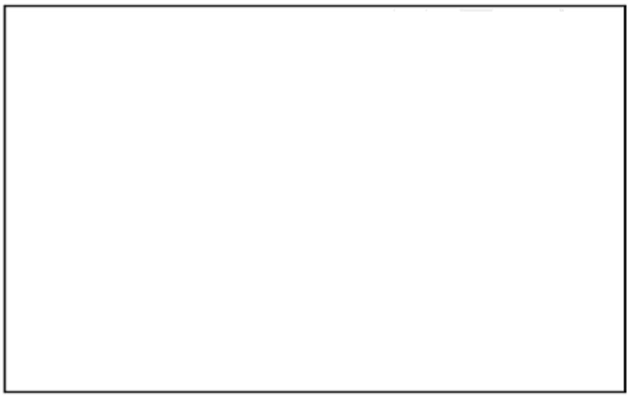


Figure 12 The Difference image between **raw** and RLDH Technique (zoom %1600)

3.1 Performance Comparison: JPEG vs Raster Line Difference Huffman Technique

The following table compares the JPEG images with RLDH Images in terms of compressed size, compression rate and saving percentage . The figures shown for Lossy RLDH technique are produced for threshold value 8. The table demonstrate that all the proposed techniques provide much better compression rate in most of the cases compared to JPEG technique.

Name of the Image	BMP CR	BPT CR	RLDH LLT CR
brain	1.35	1.454456	1.8992
chest xray	0.954	1.167867	1.4546
foot	1.78	2.245621	2.5785
knee joint	1.14	1.245622	1.6663
Head Scan	1.123	1.145658	1.6551
shoulder	1.164	1.507454	1.8954

Table 2 : Size of the different Coding Technique images are compared with Raw size

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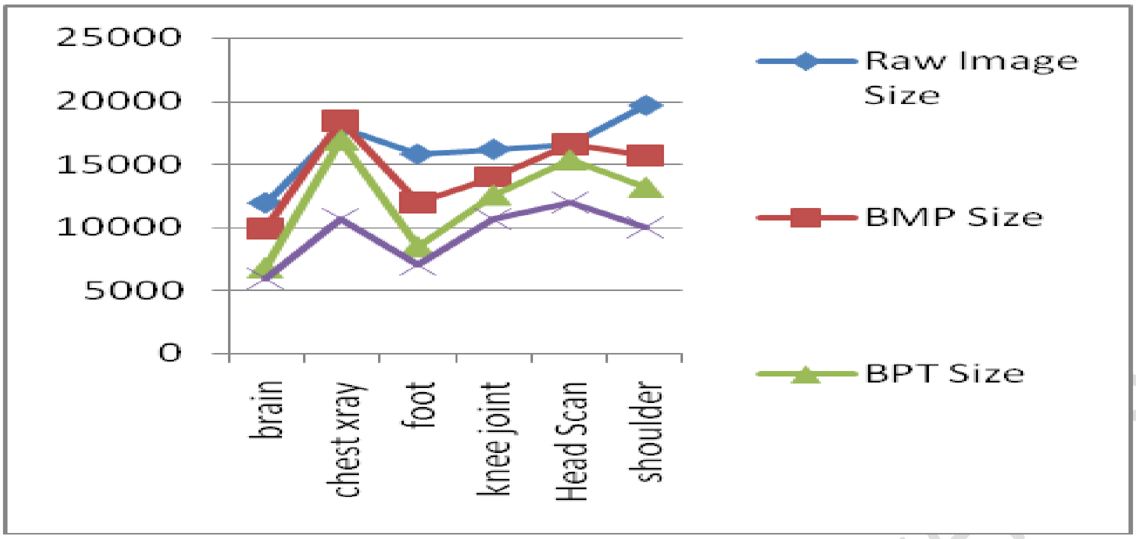

Fig 13 Line graph of Medical Images Compared with Raw Size

Figure 13 demonstrate the size of different Medical images . For each medical image different loss less compression Techniques are enforced .An amount of size required is purely depend on the loss less compression technique. An amount of size required is compared with original RAW size and standard BMP size of medical images[8]. Binary Plane technique with Huffman lossless compression technique is enforced on for images and a line graph is plotted based on amount of size required. Finally RLDH Technique is enforced on for all images shown in fig and line graph is plotted based on amount of size required .Out of all loss less compression techniques as explained above RLDH Technique is better technique for compression as amount of size required is less when compared with other lossless Compression techniques. Hence RLDH Technique is atmost apt for storage of medical images as amount of size required is less .

Table 3 : Compression Rate(CR) of the different Coding Techniques are compared with BMP Compression Rate

Name of the Image	BMP CR	BPT CR	RLDH LLT CR
brain	1.35	1.454456	1.8992
chest xray	0.954	1.167867	1.4546
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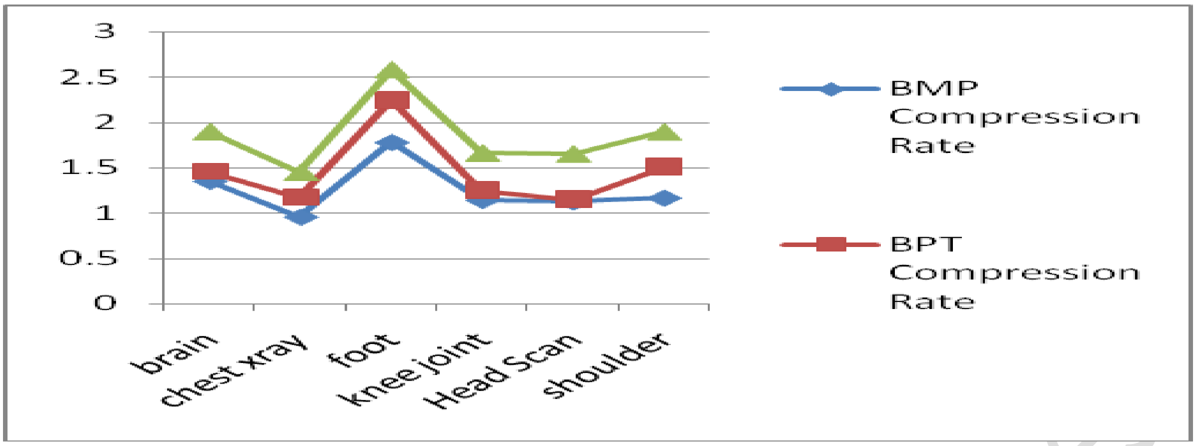

Fig No 14 CR of Loss Less Techniques on Medical Images

Fig 14 demonstrate the CR of different compression techniques on medical images .CR of each medical image is compared with standard BMP compression rate. Binary Plane technique with Huffman technique is enforced on for all images and CR is evaluated. Hinge on CR line graph is plotted. Finally RLDH Technique is enforced on for all images and CR is evaluated and line graph is plotted. Out of all techniques explained above RLDH Technique is better

4.Conclusion:

Compression the images efficiently is one of the major problem in image applications. So we have tested the efficiency of image compression using Hash table and Huffman code technique. The Lossless algorithm is applied for image. This work may be extended the better compression rate than other compression Techniques. The performance of the proposed compression[9] technique using RLDH. This technique can be applied on luminance and chrominance of color images for getting better compression.

Refrences:

1. Dr.T.Bhaskar Reddy, S.Mahaboob Basha,Dr.B.Sathyanarayana and “Image Compression Using Binary Plane Technique” Library Progress,vol1.27, no: 1, June-2007, pg.no:59-64.
2. D.A.Huffman, A method for the construction of Minimum-redundancy codes, Proc.IRE, vol.40,no.10, pp.1098-1101, 1952
3. C. Saravanan, R. Ponalagusamy (2010) “Lossless Grey-scale Image Compression using Source Symbols Reduction and Huffman Coding” International Journal of Image Processing (IJIP), Volume (3): Issue (5)
4. Mamata Sharma,”Compression Using Huffman Coding”,IJCSNS International Journal of Computer Science and Network Security ,VOL.10 No.5,May 2010,pp 133-141
5. Sunil BhooshanShipra Sharma “An Efficient and Selective Image Compression Scheme using Huffman and Adaptive Interpolation” 2009 IEEE
6. Rafael C.Gonzalez,Richard E.Woods “Digital Image Processing “Second edition Pearson

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7. G.C Chang Y.D Lin (2010) “An Efficient Lossless ECG Compression Method Using Delta Coding and Optimal Selective Huffman Coding” IFMBE proceedings 2010, Volume 31, Part 6, 1327-1330, DOI: 10.1007/978-3-642-14515-5_338.
8. Dr. T. Bhaskara Reddy , Miss. Hema Suresh Yaragunti ,,Dr. S. Kiran , Mrs. T. Anuradha “A Novel Approach of Lossless Image Compression using Hashing and Huffman Coding” , International Journal of Engineering Research & Technology (IJERT) ,Vol. 2 Issue 3, March - 2013 ,ISSN: 2278-0181. www.ijert.com.
9. Dr. T. Bhaskara Reddy ,Hema SureshYaragunti “An Efficient Approach For Image Compression using Segment, probalistic and entropy based encoding “. Ijcset, Vol 3. 2014. PP 200-207, Impact factor 2.52

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