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Fractal Image Compression using Modified Tiny Block Size Processing Algorithm and Quantum Search Algorithm

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ABSTRACT: Image compression is an essential technology in multimedia and digital communication field. Fractal image compression is one of the most widely approved image compression approach for its high compression ratio and quality retrieved images but there is a problem computational complexity in fractal image compression. We use interdisciplinary approach of Grover Quantum Search Algorithm to reduce this problem. The retrieved image from this Grover's Quantum search Algorithm is less distorted. In order to improve the quality of retrieved image. We use Tiny Block size processing Algorithm together with Quantum Search Algorithm, so compression ratio increases.

KEYWORDS*:* Image compression, Fractal Image Compression (FIC), Grover's Quantum Search algorithm (QSA), TiBs (tiny block-size processing Algorithm).

I. INTRODUCTION

Due to the advancement in the digital image processing, now it became possible to capture the image of high resolution using devices like i-pod, digital camera, mobile etc. Further, technology of wireless plays a vital role in transferring the image from one place to another place that is transferring the image from one location (source) to another location (destination). Generally the image is represented by the bits and these images are transferred by using the packet at the source and the destination. The advantage of using this technique is energy consumption at the source node and the destination node. Image compression will leads to saving of energy. [1] Image compression is a technology which is generally used for reducing the data required for image storage. There are two types of Image compression lossy compression and lossless compression technique. In lossy digital image compression, there is a loss of small amount of data after compression which is acceptable in natural photo. The lossless digital image compression is a noiseless technique. In this technique the redundancy is completely removed. This technique is mostly prefer for comics, drawing etc. [2]

Fractal image compression was proposed by Jacquin. Now a day, there is a increase in development of FIC and its application. The FIC is based on self-similarity of the same image. Due to the FIC, it is possible to reduce the space required for storage in digital image. But it is very difficult to search the large amount of self similarity in the image. This technique consumes more time and also has much more complexity. Recently lots of algorithms have been proposed. [3]

In order to find some amount of information in computer memory, some amount of searching is carried out. In a classical computer, in order to find particular element in the randomly ordered array of N element, it requires order of N/2 attempts. The same example of this is, Imagine in mobile contact list, the number of contact number of different person are arranged in random order. In order to find someone's contact number in contact list, then classical algorithm find his contact number with the N/2 names. The probability of finding the contact number is ½. Finally, L.Gover invented one algorithm, that algorithm is nothing but Grover's quantum search algorithm. By using this algorithm, it is possible to search contact number or particular entry in only $O(\sqrt{N})$ attempts. QSA is able to achieve the desired element quickly.[4-5]

Some small amount of information loss occurs in digital image which cannot be noticed by human eye. Hence now a day lot of research work is focused on lossy compression. Generally lossy compression gives lossless result. TiBs is a

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tiny block size encoding technique which works on block size of 3×3. Generally, other technique works on the block size of 2×2. Hence this modified TiBs algorithm provides good quality of retrieved image and energy consumption. [6]

II. RELATED WORK

In [3] authors suggested several technique and improvement to speed up the fractal image compression. They also present a review of technique published for faster fractal image compression. From this it is observed that, Feature vector technique is one of them. The Feature vector techniques accompanying predefined data-structures provide much better performance with some restriction in area of application. In [7] authors uses separate domain block for each range block. So the encoding time is reduced. Domain classification is based on parametric value. In [8] authors employ the Quantum Search Algorithm theory in order to reduce computational complexity of Multiuser detector when compared with Maximum likelihood multiuser detector then they demonstrate direct sequence code division multiple access and they compared with maximum likelihood multiuser detector in terms of performance and complexity. Computational complexity is reduced. But it supports numerous user and higher order modulation scheme. In [9] authors propose an interdisciplinary approach by using Grover's QSA to reduce the intrinsic computational complexity of FIC. In particular, both domain blocks and range blocks are represented as quantum states, and then Grover's QSA is employed to search the most similar domain block for each range block under the criterion of maximizing quantum fidelity. From this it is observed that a bran-new way to solve akin acceleration problem, theoretical deduction and maintain the quality of retrieved image. In [6] authors uses tiny block size encoding technique for Bayer color filter array. They use the technique named adaptive codeword generation to adjust the divisor of Rice code. It is observed that original image is compressed up to 3 times with good quality of image. In [10] authors uses three technique nearest neighbor, bilinear interpolation and bicubic interpolation and they concluded that the image is more accurate than traditional method.

III. MODIFIED TIBS ALGORITHM

TiBs algorithm is a lossy compression which provides communication between images with less complexity in an energy efficient manner. Generally the estimation of DWT and DCT is intensive and the encoder which is used in TiBs avoids the use of DWT or DWT. The 2*2 pixel block is used in this algorithm. There are three stages like pixel removal based on self-adaptive, uniform scalar quantization and variable length coding. Based on these three stages encoding and decoding is done. [6]

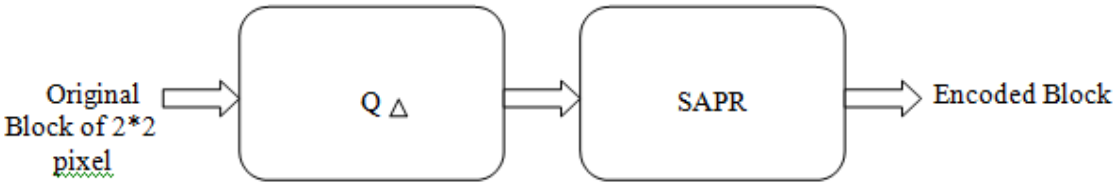

Fig1.Block diagram of TiBs Algorithm

IV. QSA ALGORITHM

Quantum Algorithm search best matching domain block for every range block. In Quantum scenario, the proximity between two states is measured from the Quantum fidelity. In the Quantum based FIC, the best matching domain block for every range block is determined by maximizing their quantum fidelity.[9]

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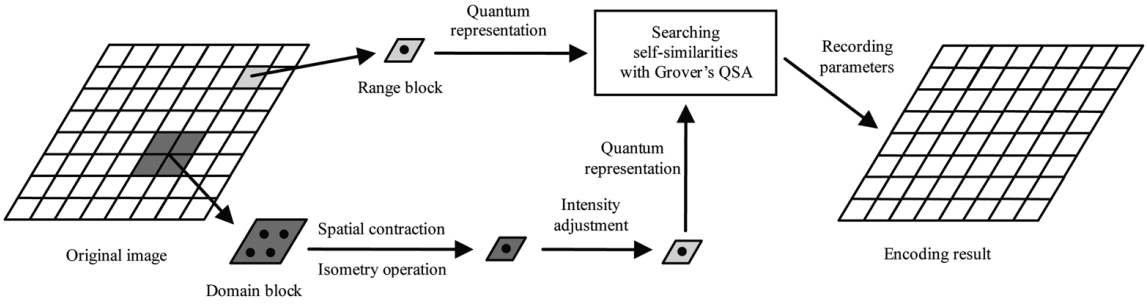


Fig 2.A brief illustration of the proposed QAFIC

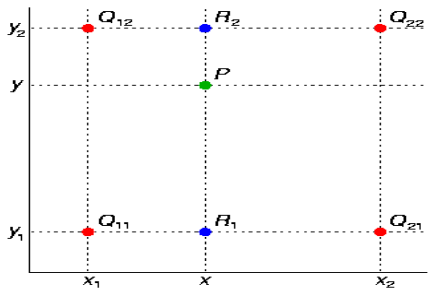
Read the input image. Partition the image into range block(R) of size B×B. Partition the image into domain block (D) of size 2B×2B. Perform the spatial contraction of domain block to a size of B×B. Represent both block as Quantum state. To improve the quality of image, eight isometric operations are applied. Quantum representation is used to capture the information about the color and their corresponding position in the image.QSA matches the D with R, we get the encoded result.

V. RESIZING CONCEPT

Interpolation occurs when we resize any image from one pixel grid to another. Image Interpolation is the process of using known data to estimate the value at unknown location.

Types of Interpolation

1. Nearest Neighbor Interpolation: In this method, it searches the closest intensity pixel in the original image and assigns that pixel to the new image.
2. Bilinear Interpolation: This method is used to estimate the intensity of any location.



To calculate the value of pixel P we have to calculate the value of R1 and R2.

Q12, Q22, Q11, Q21 represent nearest pixels from the original image whose value is known.

R1 is an average of Q11 & Q21

R2 is an average of Q12 & Q22

R1 = ((x2-x)/(x2-x1))*Q11 + ((x-x1)/(x2-x1))*Q21

R2= ((x2-x)/(x2-x1))*Q12 + ((x-x1)/(x2-x1))*Q22

P = ((y2-y)/(y2-y1))*R1 + ((y-y1)/(y2-y1))*R2

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VI. PROPOSED ALGORITHM

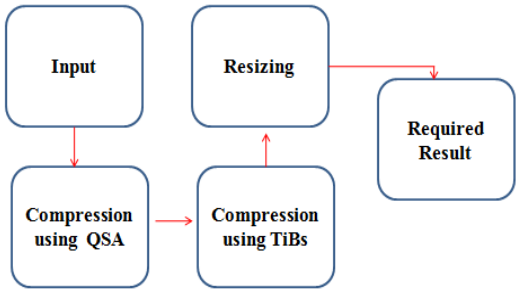

Fig.3. Fractal Image compression and Decompression using QSA and TiBs algorithm

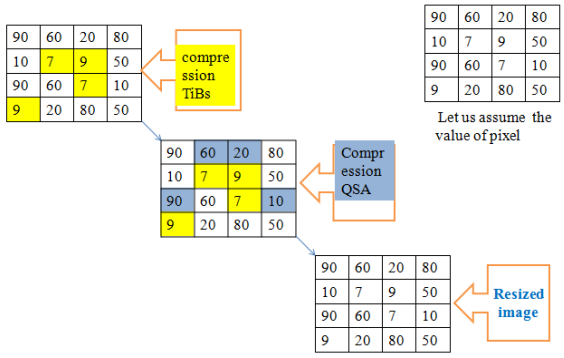

Fig4. Example of Image Compression using QSA and TiBs

A. *Steps involved in QSA and TiBs*

1. Consider the input image of pixel size 4×4.
2. Partition the image into 2×2 blocks
3. To compress the image using TiBs, search the minimum value from 2×2 pixel block and remove it.
4. To compress the image using QSA, search the similar value pixel from the 4×4 pixel block and remove one pixel out of similar value.
5. To obtain the original image resizing is done.

B. *Description of the Proposed Algorithm:*

1. Calculating Peak Signal to Noise Ratio (PSNR)

PSNR is most commonly used to measure the quality of reconstruction for image compression. PSNR is the ratio between maximum possible power of a signal and power of corrupting noise.In this case, signal is the original image and noise is the error introduced by compression.

$$\text{PSNR} = 20 \log \frac{\text{Max}}{\sqrt{\text{MSE}}}$$

Here, Max pixel value of the image.

MSE measure the average of the square of the error. It gives quality of image. It is always non negative, and value closer to zero is better.

2. Calculating Compression Ratio (CR)

Compression ratio is a measure of the reduction of the important coefficient of the data.Compression ratio is given by

CR= (Decompressed image) / (original image)

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VII. SIMULATION RESULTS

The compression ratio and improved quality of retrieved image are explained by the experimental results. The proposed method is implemented in matlab and ModelSim. The whole programming of the project is in modelsim and matlab is used to display image. Fig5 shows compressed image by using QSA. Fig6 shows position of similar pixel by using QSA. Fig 7 shows compressed image by using TiBs algorithm. Fig 8.shows compressed and decompressed image by using QSA and TiBs Fig 8 shows theoretical result of compressed and decompressed image by using QSA and TiBs.

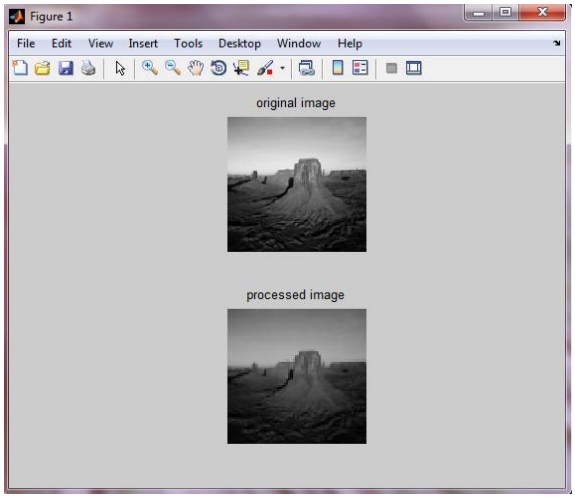

Fig.5. Compressed Image by using QSA Algorithm

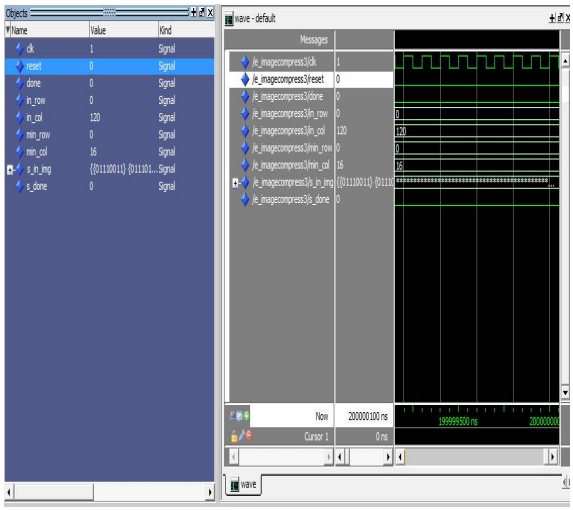

Fig6. Position of similar pixel by using QSA

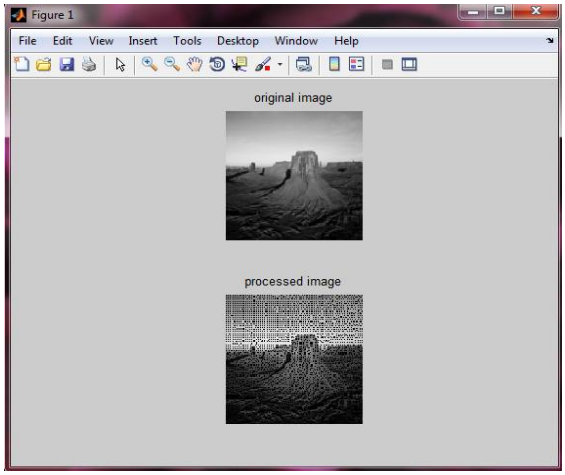

Fig 7. Compressed image by using TiBs Algorithm

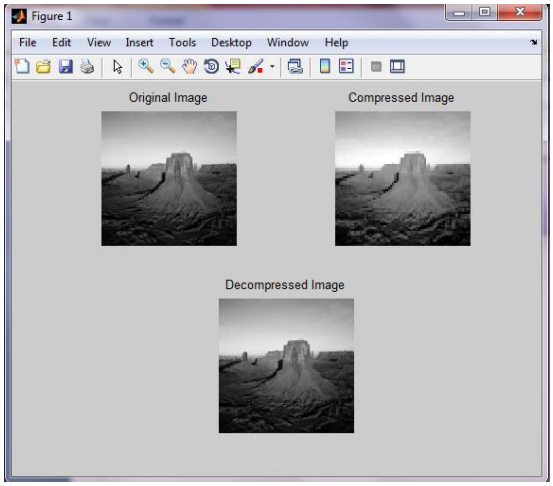

Fig.8. Compressed and Decompressed Image by using QSA and TiBs Algorithm

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Fig.9.Theoretical result of Compressed and Decompressed Image by using QSA and TiBs Algorithm

DESCRIPTION OF TABLE

In [7], authors presents a light weight modified TiBs Algorithm for Image compression. They had done the comparison of PSNR and Compression ratio by using Modified TiBs Algorithm for different image. We compared the PSNR and Compression ratio of Modified TiBs Algorithm with the PSNR and Compression Ratio of Proposed Algorithm i.e. Combination of Modified TiBs Algorithm and Quantum Search Algorithm.

Image	Modified TiBs		TiBs & QSA	
	PSNR (dB)	CR (%)	PSNR (dB)	CR (%)
Tulip	83.56	26.56	24.8182	81.25
koala	83.15	27.76	25.0726	81.25
Desert	83.25	26.10	25.6016	81.25
Hydrangeas	82.84	28.93	27.0122	81.25
Jelly Fish	83.71	24.82	28.9185	81.25

Fig. 10 Comparison of result for different images

VII. CONCLUSION

For compression of digital image there are many algorithm exist and lot of researcher have been proposed various algorithm on Fractal image compression. In the proposed system, Quantum search Algorithm together with Tiny Block Size Processing Algorithm are used which follow the different path to reduce the computational complexity of Fractal image compression. In Quantum Search Algorithm, the computational complexity of Fractal image compression is reduced. Tiny Block Size Processing Algorithm increases the compression ratio and improves the quality of retrieved image. In proposed Algorithm, the Compression ratio increases than the Compression ratio of Modified Tiny Block Size Processing Algorithm. In future, certain modification can be made in compression ratio and PSNR. The system can be demonstrated for videos.

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