Abstract: Within the domain of image processing the applications of the fractal image compression through the affine transform is rarely implemented. The major drawback it consists is its time consumptions in simulations as well as in hardware implementation. The reason behind this is its comparatively matching the range blocks with the varied number of domain blocks. Additionally, the compression ratio obtained from this sets of techniques are much more that the other similar working techniques. In order to overcome, this drawback, here a concept of intensity mismatch searching techniques is intruded within this particular paper. While in the mean time, it only concluded in much reduce in time of searching for similar domain block form a pool. And also this technique does not affect within the compression ratio and PSNR measurement form the retrieved image. Further benefited in hardware applications where the matters for time consumptions is a major factor.

Keywords : fractal image compression, time consumption, intensity mismatch, range block and domain block.

I. INTRODUCTION

In today’s world, the usage for cameras for image capturing turns into a vital component. Due to which a high increment upon storage data is primarily concerned under the database structure. Moreover, a varied number of impacts are intercepted within the main coursed regarding storages of data in small allocated data sets. For that reason the use of fractal image compression techniques is used. The steps initiated by the fractal image compression [1-3] are based upon the concept of “Portioned Iterated Function System” or in short PIFS [4-6]. That basically works upon estimating the actual requirements of blocks that are needed to be present within the compressed image. Therefore, much more less number of storage data will be allocated with the purpose of storing the image. In order to do so, the technique used in fractal image compression [7] is to divide the image into two large blocks, which consists of, the main image or the range blocks and in other the domain blocks. Then the further process of checking for similar weight age of the rage blocks will processed proceed towards matching with the domain blocks within the pool, so that the coordinates of the main block will be noted down for further information content of data. Therefore the recovery of the overall sets of blocks and the original image can be easily processed while needed. The overall process initiated through the fractal image compression technique is described as:-

Therefore, lastly a minimum data is initiated for the storage of image information within the hardest. At the same time, while it is required to receive the details within image, then the decompression technique is initiated. That helps in obtaining the contents of data that are stored within the original image with an effect of lossless or lossy contents in data. Here in next section the in-depth working steps for fractal image compression is discussed, and then the further proposed work is discussed in third section. Additionally, the obtained result with the conclusion and discussion is also held in the fourth and fifth section.

II. FRACTAL IMAGE COMPRESSION

According to Fisher and Yuval, the outcomes of fractal image compression is in higher compression rations, but the major drawbacks for is the compression speed initiated for the overall operations. Additionally, the actual processing of finding the matches between the Domain pool and range blocks are mainly consists in the linear way, due to the learner process of processed the matching facilities with the domain blocks in different geometrical concepts, consumed the time as well as cause the major drawbacks of the method. That overall method of finding the match between domain and range blocks are processed into different geometrical rotation orders; in order to achieve more compression rations [2]. However, the major drawbacks of attaining operated speed along with consumption of time are remained negligible changes. Among the geometrical matching facilities, the processes of tilting, rotating and reflection of the range blocks are considered to check over the preferable domain blocks. That is further described as the isometric matching operations within FIC.

The range pixels will then be approximated by,

\[ R(i,j) = S_x l(i,j)+O. \]

The more is the domain pool, the more possibilities are there for a good quality of matching to occur. In order to expand the domain pool, the domains are used to create it's 8 isometrics namely,

I. Identity:

\[ I_d (i,j) = I_o (i,j) \]
II. Reflection about mid vertical axis:
\[ I_y(i, nd-j+1) = I_y(i, j) \]
where \( nd \) is the pixel dimension of domain.

III. Reflection about mid horizontal axis:
\[ I_x(i, nd+i+1) = I_x(i, j) \]

IV. Reflection about first diagonal:
\[ I_d(i, j) = I_d(i, j) \]

V. Reflection about second diagonal:
\[ I_d(nd-j+1, nd+i+1) = I_d(i, j) \]

VI. 90° rotation:
\[ I_y(i, nd+i+1) = I_y(i, j) \]

VII. 180° rotation:
\[ I_y(nd+i+1, nd-j+1) = I_y(i, j) \]

VIII. 270° rotation:
\[ I_y(nd-j+1, i) = I_y(i, j) \]

The domain with the minimum MSE will get selected to best approximate the range. The modified domain pixels are obtained after evaluating the contrast scale factor \((s)\) and the brightness offset factor \((o)\).

\[
MSE = \sum (sd_i + o - t_i)^2
\]

\[
S = \frac{\sum d_i t_i - \sum d_i \sum t_i}{\sum d_i^2 - (\sum d_i)^2}
\]

\[
o = \frac{\sum d_i - S \sum t_i}{n}
\]

When FIC is conducted for a 256X256 grey scale image using range of dimension 4X4 and domain of dimension 8X8 then, a full search encoding will take up more than 30 minutes in a software approach using MATLAB. Thus in order to make the compression realisable in real time various techniques can be taken up to constrict the domain set to be compared to a particular range. One technique is to consider those domains which are in close vicinity of the range block. Other techniques like stopping the comparison of domain blocks for a range block after a domain is obtained which produces a MSE less than some pre-fixed value or threshold. Such a technique was used by [3], in their hardware implementation on an ASIC. The notion of parallelism is utilised the great extent in hardware approaches to make calculations faster. Techniques like setting up a classifier vector to segment both range and domain into different classes or groups is utilised by Samavi et al. So, only domains belonging to the same class as that of the range will only get considered. While [4] used Bit width optimisation to make faster calculations by sacrificing the precision of calculation to some certain extent.

### III. PROPOSED WORK

In this paper a metric is utilised which takes into consideration the average intensities of the range and the domain blocks. For a good approximation the average intensity of the domain should be close to the average intensity of the range. More the mismatch between their average intensities, more error will get added if such a domain is selected to approximate the range block. So, a intensity mismatch parameter is created which is the absolute value between the average intensity difference between range and domain.

If for a certain domain the intensity mismatch value is less than the pre-fixed intensity mismatch threshold then, for only such domains we will proceed to evaluate the contrast scale factor \((s)\), the brightness offset factor \((o)\) and finally the mean square error \((\text{MSE})\). Since most of the available domains would not produce an intensity mismatch value less than the intensity mismatch threshold value, thus a lot of time is saved. Also since, the calculation of \(s\), \(o\) and \(\text{MSE}\) is more time consuming. Therefore, a fixed threshold is set which not only domains with average intensity value quite close to that of the range's value are considered but, domains with drastic difference in average intensity value from that of the range's will also get entertained. This is bound to increase the encoding time. Thus, for a certain range domain pool is available for selection the quality of the reconstructed image will be better than if we set a intensity mismatch threshold of 0.5. To further decrement the encoding time, the proposed techniques by [3] is considered. of stopping the range-domain matching process once such a domain is obtained which gives a MSE less than some pre-fixed threshold. Although this will slightly degrade the quality of reconstructed image but, improvement in compression time is much more advantageous.

### For compression

1. Store image into a 3-D model with size measurement
2. Obtain and store 8 Isometric transformations of the domain blocks
3. From 4 domain pixels in a block the MSE and intensity mismatched threshold is set
4. For single range blocks all domain blocks are made accessed
5. Reallocated the domain block in range via matching the MSE and intensity by detecting algorithm
6. In case unmatched range found then overall searching process will be executed

The obtained comp matrix is the compressed image. In order to make the compression ratio higher, 7 decimal digits to represent the contrast scale factor \((s)\) and 5 decimal digits to represent the brightness offset factor \((o)\).
For the s, we observed that the absolute value of s mostly lies between 0.1 and 1.5 but sometimes it becomes a 2-digit number. Certain number from decimals numbers are sorted for further interrogates processes. Similarly o is generally a 2 or 3 digit number but, sometimes it may be a 4 digit number. Similarly the decimals numbers are also sorted for further easy achievement. Along with the selected domain number we concatenate all these digits to form a single number and store them in a transmit matrix. The data in this matrix can easily be converted into bits and then transmitted. For a 256X256 image it can be observed that compression ratio of 2.37 and 9.48 is obtained for 4 x4 and 8x8 range blocks.

For decompose

- Concatenated values are extracted and stored in different matrixes
  
  \[ \text{concatenate} \Rightarrow \text{output matrix} \]

- Take a sample image and evaluates the range pixels in it
  
  \[ \text{image} \Rightarrow \text{range blocks} \]

- Use the domain blocks for recovered the matrix
  
  \[ \text{domain blocks} \Rightarrow \text{recovered image} \]

- After 10 iterations same original image will be achieved

IV. RESULT AND DISCUSSION

- For images of dimension around 128X128, if PSNR is to be maximised (better quality) range blocks of dimension (2X2) is used with intensity mismatch threshold of 1. If compression time is to be minimised range blocks of dimension (4X4) is selected with intensity threshold above 10.
- For images of dimension around 256X256, if PSNR is to be maximised, range blocks of dimension (4X4) is utilised with an intensity mismatch threshold of 10 and above. If compression time is to be minimised range blocks of dimension (4x4) is selected with intensity threshold above 1.
- For images of dimension around 400 X 400 , if PSNR is to be maximised, range blocks of dimension (4X4) is utilised with an intensity mismatch threshold of 1 . If compression time is to be minimised range blocks of dimension (8X8) is selected with intensity threshold above 10.
- For images of dimension in and above 512X512, range blocks of dimension (8X8) is used with intensity mismatch threshold of 1.
- For range blocks of (2X2) dimension, mean square error threshold of 0 is utilised.
- A mean square threshold of 250 will keep the PSNR as well as the compression time to an acceptable limit.
- For images of dimension around (256X256), if compression ratio is to be maximised with finite degradation of PSNR, range blocks of dimension (8X8) is utilised with intensity mismatch threshold greater than 10 and mean square error threshold of 0. This will lead to a finite increment in compression time.

- Range blocks of dimension (8X8) leads to a compression ratio lying between 9.5 to 10.3, while (4X4) range block scan best give us a compression ratio of 2.4. For a 256X256 image normally 4X4 range blocks are used cause using8X8 range block degrades quality of reconstructed image. For Cameraman 256X256 image using 8X8 range blocks with intensity mismatch threshold of 1 can best give PSNR of 20.42 with 2.48 sec compression time with mse threshold of 0. For Lena 256X256 image using 8X8 range blocks with intensity mismatch threshold of 50 can give PSNR of 23.1 with 10.47 sec compression time with mse threshold of 0.

Comparison between proposed and contemporary Techniques:

<table>
<thead>
<tr>
<th>Platform</th>
<th>Proposed</th>
<th>Vidya(8)</th>
<th>Samavi(9)</th>
<th>Jackson(10)</th>
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<tr>
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<td>Simulation</td>
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<tr>
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<td>256X2</td>
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<tr>
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<tr>
<td>Range block size</td>
<td>4 X 4</td>
<td>8 X 8</td>
<td>4x4</td>
<td>8 x 8</td>
</tr>
<tr>
<td>PSNR of Lena image (dB)</td>
<td>25.41</td>
<td>23.1</td>
<td>28.1</td>
<td>25.3</td>
</tr>
<tr>
<td>Compression ratio</td>
<td>2.46</td>
<td>9.77</td>
<td>4</td>
<td>26</td>
</tr>
<tr>
<td>Coding time</td>
<td>2.41s</td>
<td>10.47s</td>
<td>14.1s</td>
<td>0.8 ms</td>
</tr>
</tbody>
</table>

V. CONCLUSION

This proposed algorithm assures to get PSNR above 25 in most of the sample images and compression time of less than 10 seconds in most simulations. It is flexible towards the selection of dimensions of the range blocks. For 512X512 image range block of dimension 8X8 is used extensively while for 256X256 images the dimension of range block is a matter of preference.
If compression ratio is given higher preference before PSNR then range blocks of 8X8 gives PSNR around 23dB and compression ratio above 9.5. If PSNR is given higher importance before compression ratio then range blocks of 4X4 gives PSNR greater than 25dB and compression ratio around2.5. The computationally heavy processing steps in FIC deters the implementation of this technique for real time applications. Efforts are being made to reduce the processing time so that, the high compression ratio offered by FIC can be exploited.

REFERENCES
4. Iterated Systems Inc. changed its name to MediaBin Inc. Inc. Archived 2008-01-31 at the Wayback Machine in 2001 and in turn was bought out by Interwoven, Inc. in 2003
8. D. Vidy, R. Parthasaratathy, T. Bina, N. Swaroopu, Architecture for fractal image compression, J. Syst. Archit. 46 (14) (20 0 0) 1275–1291, doi: 10.1016/ S1383-7621(0 0)0 0 018-7

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