DESIGN OF REDUCED DELAY AND EFFICIENT 2D DCT ARCHITECTURE FOR IMAGE COMPRESSION

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ABSTRACT

In today's life, multimedia is a major application for most of the image/video processing. In addition to that, the main source of image processing system can be obtained using Discrete Cosine Transform (DCT).This low error DCT can be effectively attained using registers as D flip flop for enhancing pipelining technique. Thus produces relatively less processing time and efficient memory usage.

Keyword:-*DCT, image compression, Loeffler algorithm, reduced delay, low error DCT, pipelining.*

I.INTRODUCTION

Due to the wide range usage of digitally operated image processing for various purposes, DCT plays this well. DCT is used because it consists of real numbers. It converts a spatial into a frequency domain and mainly used in image in order to develop the enhancement process. Also, it is mainly used in low power and processing speed. DCT can be applied as 1D DCT or 2D DCT process based on the processing we needed. For a still image to capture, the DCT can be used by processing each element. In audio/video encoder, DCT is applied by dividing into frames using each time slots to attain the multimedia processing.

II.JPEG IMAGE ENCODER

JPEG image is widely used in image processing. Here, DCT can be used either for 8*8 block or16*16 or 32*32 block of image. An image is subdivided into blocks. Each block has its own DCT coefficients. For 2D DCT image, the image has both horizontal and vertical components by applying matrix equation for each block.

The visualization of basic of 2 D DCT Functions are shown as AC and DC coefficients.

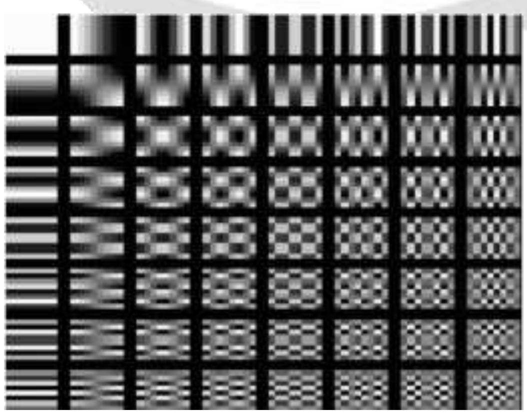


FIGURE 1 DCT PROCESS IN AN IMAGE

The JPEG image compression can be done by coding in MATLAB software. The diagram is shown inorder to obtain the reconstructed image is:

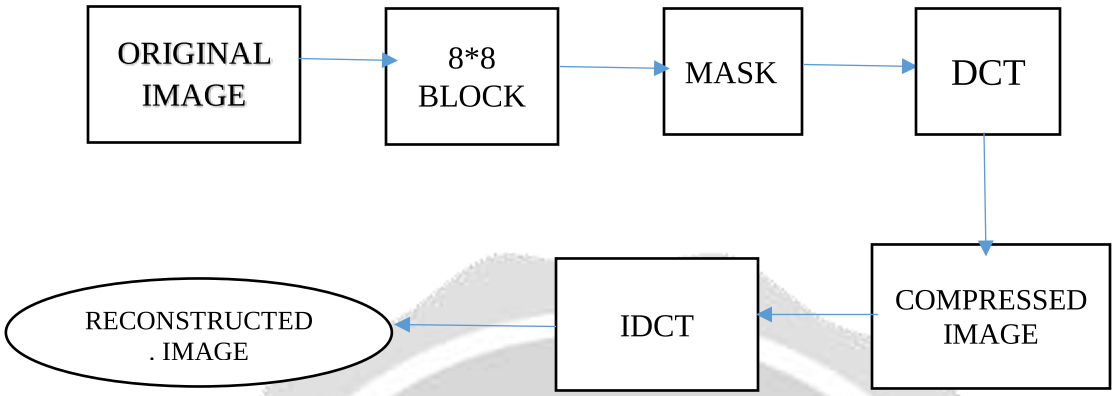


FIGURE 3 JPEG IMAGE COMPRESSION

III. LOEFFLER ALGORITHM

In loeffler algorithm .the efficient role to provide computation in 8 point DCT using various adders and subtractors. This increases complexity due to more number of components and many calculations that are needed to perform it.It has 11 multiplications and 29 additions and produces more computational time. The diagram of loeffler algorithm is shown:

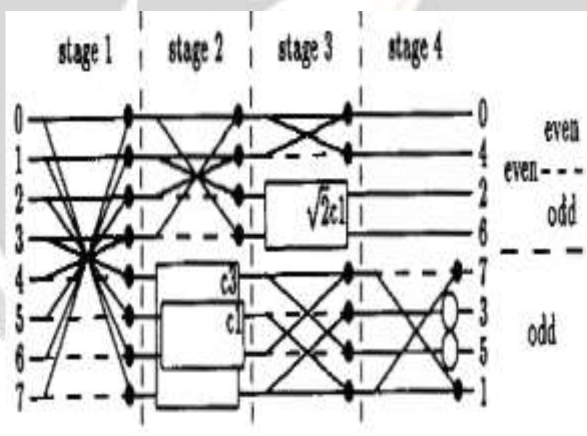


FIGURE 3 LOEFFLER 8 POINT DCT

IV. PROPOSED SYSTEM

- PIPELINING USING D FLIP FLOP

An important application of latches and flip flops is the pipelining of combinational/algebraic operation. D flip flop helps in pipelining process for parallel execution. It also increases the clock speed. Proposed system has the advantage of LOEFFLER algorithm

- Vectorprocessing-parallel multipliers
- 4 stage pipelining process using D flip flop. This enhances parallel execution.
- High PSNR and low MSE.

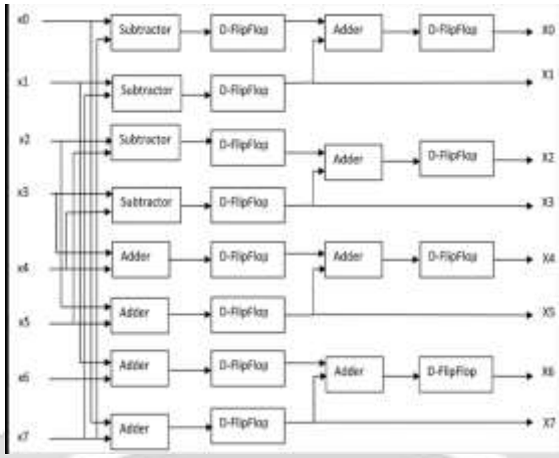


FIGURE 4 8 POINT DCT USING D FLIP FLOP

Pipelining is achieved using registers called Dflip flop. D flip flop is used since it acquires a stable state and maps the output of the previous state to next state and is more efficient. Due to this pipelining are greatly attained and hence the total time delay can be achieved than loeffler algorithm.

V. RESULTS AND DISSCUSSIONS

The image compression obtained using MATLAB software with DCT process.The DCT efficiency can be found using Xilinx Spartan 3E 6S00 device. The testbench program should be done for both loeffler algorithm and pipelined DCT using efficient D flip flop and RTL view can be obtained. Then it was interfaced with MODELSIM software and produces the DCT coefficients and the algorithm's intermediate results through detailed estimation. Also,the output values are shown .They are compared with the existing algorithm.

The 8*8 matrix of original image is shown in figure 5:

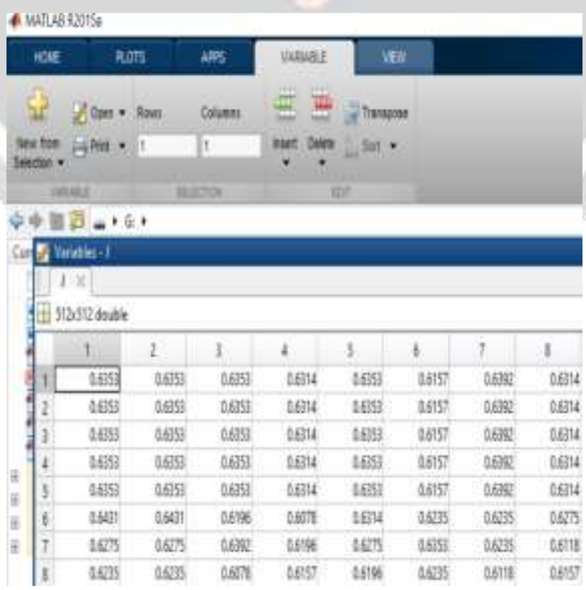
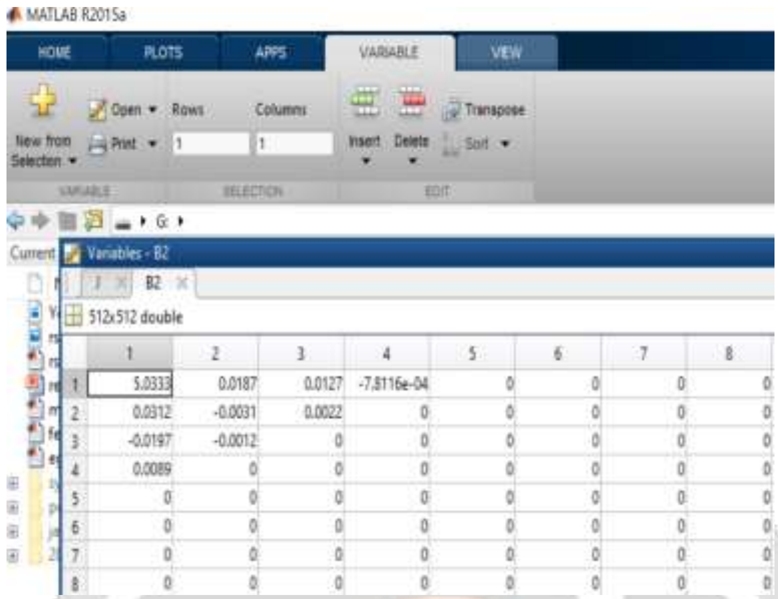


FIGURE 5 MATRIX OF ORIGINAL IMAGE

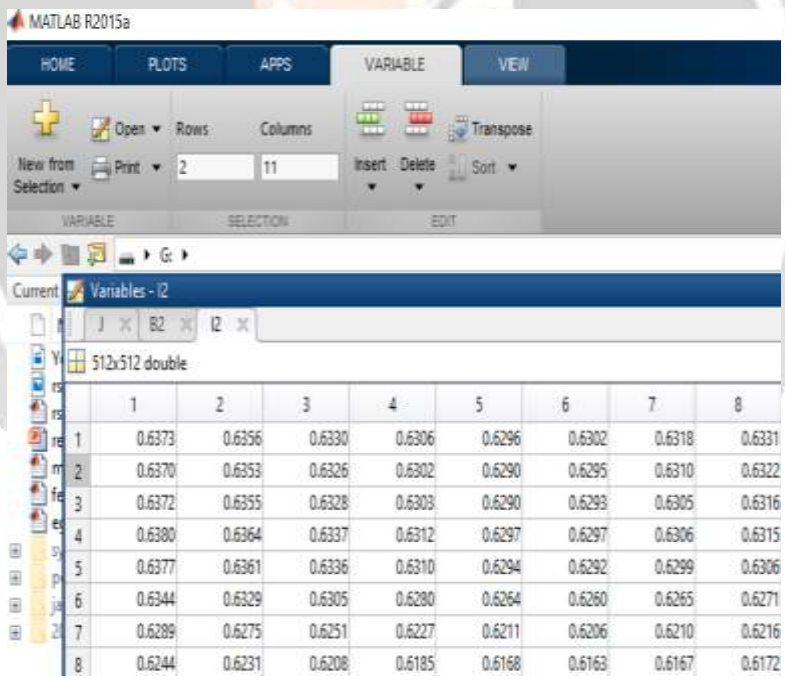
The matrix of 2D DCT image is given in figure 6 ,as only 10 of the 64 coefficients are used of low frequency values and others are discarded as shown



	1	2	3	4	5	6	7	8
1	5.0333	0.0187	0.0127	-7.8116e-04	0	0	0	0
2	0.0312	-0.0031	0.0022	0	0	0	0	0
3	-0.0197	-0.0012	0	0	0	0	0	0
4	0.0089	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0

FIGURE 6 MARTIX OF 2D DCT IMAGE

Finally the reconstructed image is obtained by applying inverse DCT, therefore the inverse DCT image is displayed in figure 7 which is same as the original image,



	1	2	3	4	5	6	7	8
1	0.6373	0.6356	0.6330	0.6306	0.6296	0.6302	0.6318	0.6331
2	0.6370	0.6353	0.6326	0.6302	0.6290	0.6295	0.6310	0.6322
3	0.6372	0.6355	0.6328	0.6303	0.6290	0.6293	0.6305	0.6316
4	0.6380	0.6364	0.6337	0.6312	0.6297	0.6297	0.6306	0.6315
5	0.6377	0.6361	0.6336	0.6310	0.6294	0.6292	0.6299	0.6306
6	0.6344	0.6329	0.6305	0.6280	0.6264	0.6260	0.6265	0.6271
7	0.6289	0.6275	0.6251	0.6227	0.6211	0.6206	0.6210	0.6216
8	0.6244	0.6231	0.6208	0.6185	0.6168	0.6163	0.6167	0.6172

FIGURE 7 MATRIX OF INVERSE DCT IMAGE

It shows how the image is compressed using MATLAB .The results are given in figure 8,

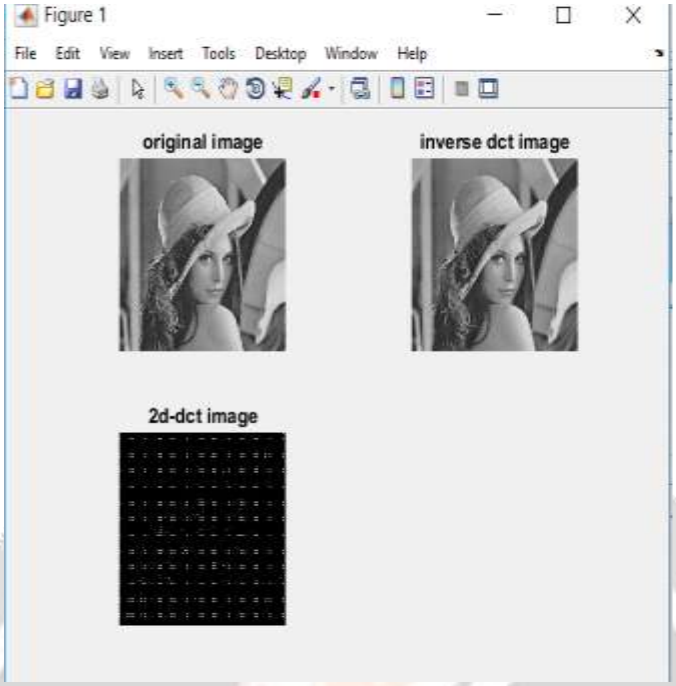


FIGURE 8 IMAGE COMPRESSION IN MATLAB

Results obtained in Xilinx through MODELSIM of exhibiting loeffler algorithm simulation shown in figure 9;

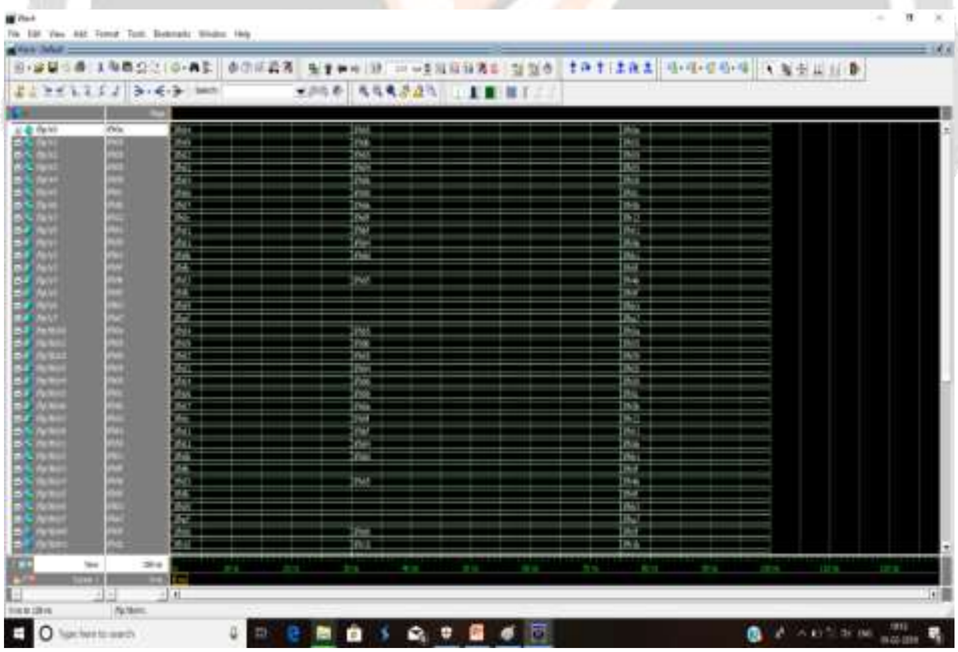


FIGURE 9 SIMULATION OF LOEFFLER ALGORITHM

- INTERMEDIATE RESULTS

  The intermediate values here is (m0,m1,m2…..,m7)and(p0,p1,p2,…..,p7) are found during calculation are obtained practically as given in figure 11:

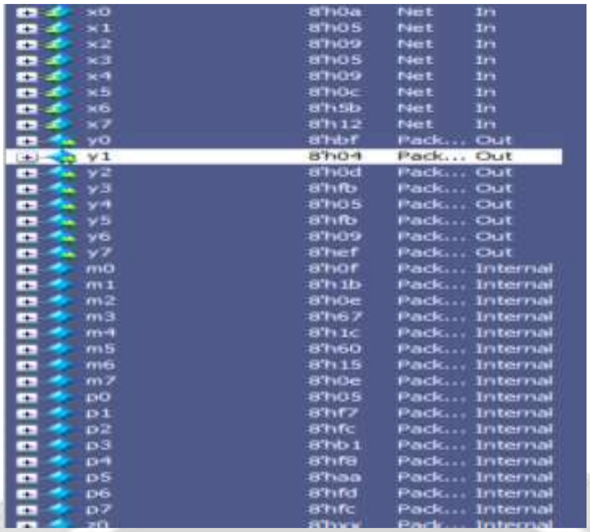


FIGURE 10 INTERMEDIATE RESULTS

RTL view using behavioural modelling of results using testbench code is displayed in figure 11:

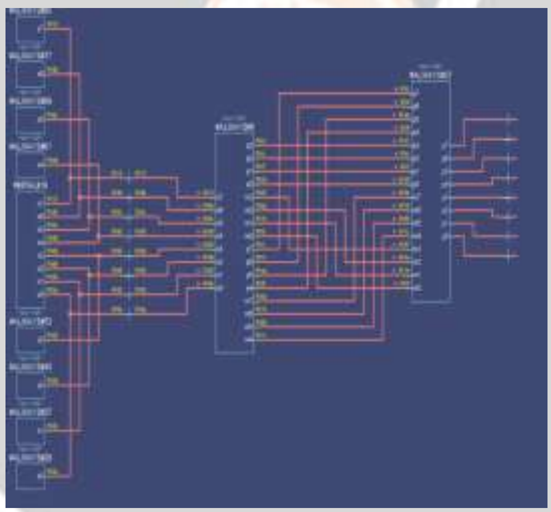
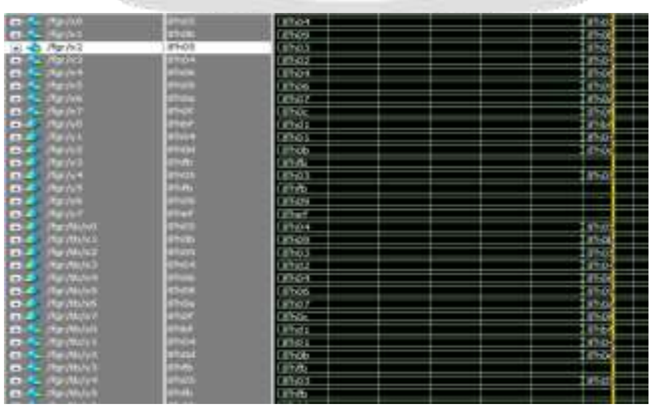


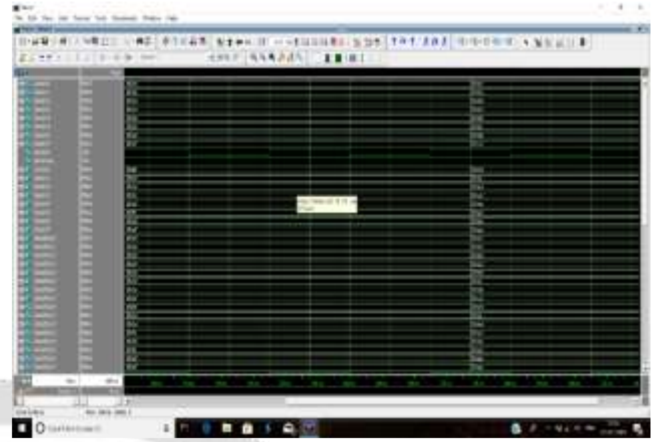
FIGURE 12 RTL VIEW OF BEHAVIOURAL CODE

- **Experimental result at 33ns**



- **Theoretical result at 33ns**

Here x(0),x(1)……x(7) are the inputs and y(0),y(1),….y(7) are the outputs.m0,m1,m2…..,m7 and p0,p1,…..,p7 are the intermediate stages



y (0)=(m0+m1+m2+m3)*255

= (9+21+6+19)*255

= 9795 (decimal value)

= 40bf (hexadecimal value)

y (0)=f (truncated to 8bits)

where m0=x (0) + x (3) = 5+4 = 9

m1=x (4) + x (6) = 6+15=21

m2=x (1) + x (2) =11+5 = 16

m3=x (5) + x (6) =9+10 = 19

- PIPELINED D FLIP FLOP RESULTS

The simulation results of pipelined d flip flop DCT structure are shown in figure 12 shows the results of 8 point DCT D flip flop. When 'CLK' signal and 'CLEAR' is set to 1, then input is mapped to output. Here, the output is 'q' as shown:

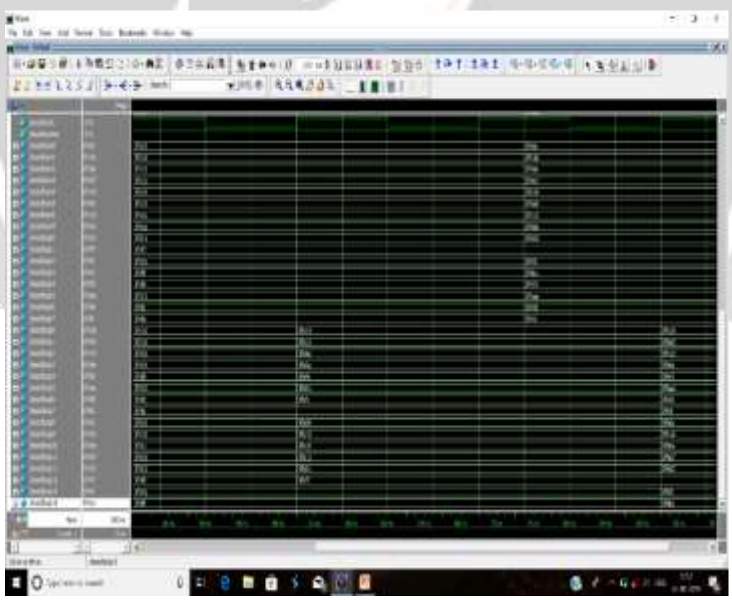


FIGURE 12 SIMULATION RESULTS USING PIPELINE

In terms of total time delay in Loeffler algorithm can be depicted as shown in figure 13.The algorithm provides the logic and arrival time for necessary time delay unit is 18.111ns. Thus the maximum frequency obtained without pipelining obtained using Loeffler algorithm is 135.52MHZ.

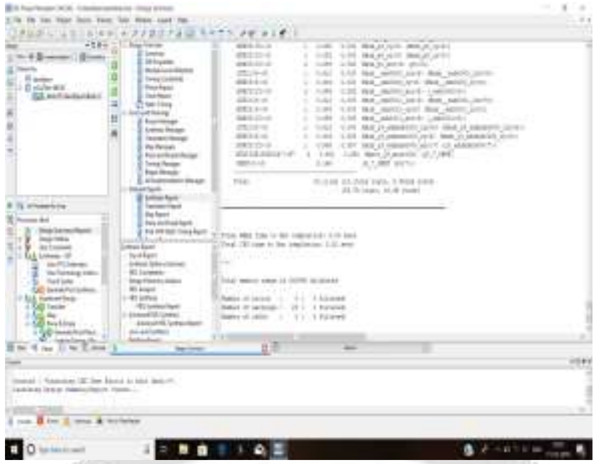


FIGURE 13 TOTAL TIME DELAY IN LOEFFLER ALGORITHM

- **Pipelined 8 Point DCT**

In terms of total time delay in pipelined D Flip Flop ,it shows better results when compared to Loeffler Algorithm. The results are shown in figure 14 ,

Here, the total time delay is 15.205 ns.Hence the maximum frequency is obtained during analysis of pipelined DCT with D flip Flop for various stages is 289.272MHZ. The results are shown as:

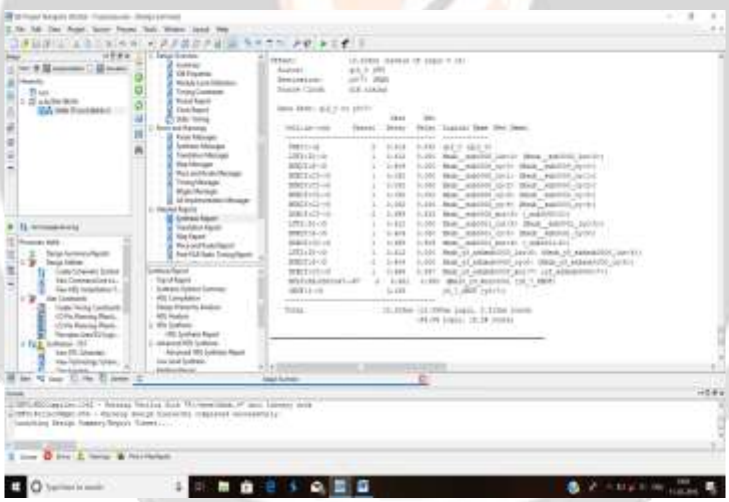


FIGURE 14 TOTAL TIME DELAY IN PIPELINED DCT USING D FLIP FLOP

VI.COMPARISON RESULTS

The comparison results of both existing and proposed system for total time delay is given in table 1.

The comparison is made between existing loeffler algorithm and pipelined Dflip flop for determining 8 POINT DCT is shown in table 1:This displays the total time delay and maximum clock frequency in pipelining than loeffler technique.

Table 1 Comparison Results

FACTORS	**LOEFFLER ALGORITHM**	**PIPELINED DCT WITH D FLIP FLOP**
TOTAL TIME DELAY	18.111ns	15.205ns
MAX. FREQUENCY	135.52MHZ	289.272MHZ

VII. CONCLUSION

Thus DCT Can Be Used To Improve Image Quality. Pipelining reduces the time taken by the critical path. High efficiency towards memory and reduced delay. This proposed reconfigurable structure of 4 stage pipelining in 8 point DCT using D flip flop has better performance in total time delay less than existing Loeffler algorithm. Thus this technique can be used widely in communication field and digital image processing systems for high quality for images like in medical image processing, where high quality is preferred over the compression of image/video transmission. As a part of future enhancement, low-power architecture for Ultra low power design is suitable for portable systems and can be implemented for both DCT and IDCT by redesigning the multipliers and adder circuits. This can be also used in future work by applying DCT for video transmission for various versions and to meet timing constraints and other specifications.

VIII. REFERENCES

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