

VLC based JPEG Algorithm

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Abstract:- In this paper, VLC based JPEG algorithm is performed. The purpose behind this is to reduce computational complexity using VLC and Loefflers algorithm. In this, we are form DCT using Loefflers algorithm. It requires less multiplication to perform this operation .Quantization is performed to obtain quantized DCT coefficients. Huffman encoding is performed to obtain encoding output. And we obtain compressed image. JPEG algorithm is a compression and decompression. Decompression is done by reversing the process of compression.

Keywords: Loeffler, VLC, Compression, DCT, Quantization, Huffman, JPEG

Introduction:

To perform JPEG operation, there is a process which has to be performed. JPEG are used for transformation of original image into number of 8x8 blocks. The original image transformation is helpful to obtain compression easily.

Steps Performed By JPEG:

1. Step 1: Level shifting is done on matrix of image.
1. Step 2: DCT performed to form DCT coefficients.
2. Step 3: Quantized DCT coefficients are formed by Quantization.
3. Step 4: VLC based Huffman coding is done.
4. Step 5: We obtain compressed output.
5. Step 6: To reconstruct an original image, reverse process is applied to obtain decompression.

System Implementation and Working

JPEG COMPRESSION:

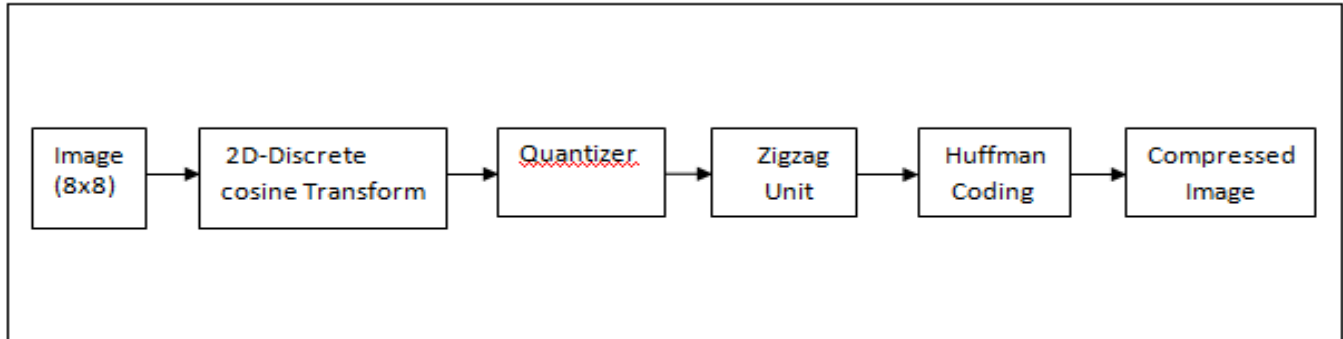


Figure- JPEG Image Compression

JPEG DECOMPRESSION:

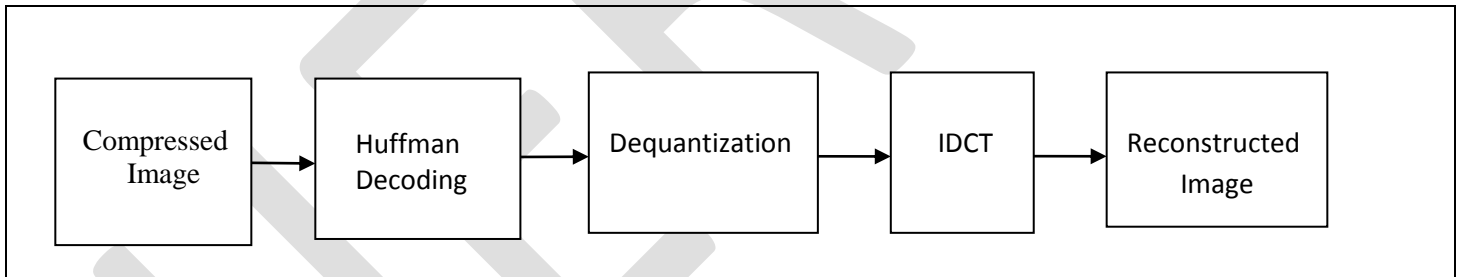


Figure-JPEG Image De-compression

DCT:

To perform DCT operation, there are number of algorithms. But we are using Loeffler's algorithm because it performs operation using less number of multiplications than other[9]. It uses 11 multiplications to perform the operation. Requirement of less multiplication than other algorithm results in a reduction of complexity[10]. To perform DCT operation, Loeffler's uses its butterfly structure. This butterfly structure is as shown in below figure.

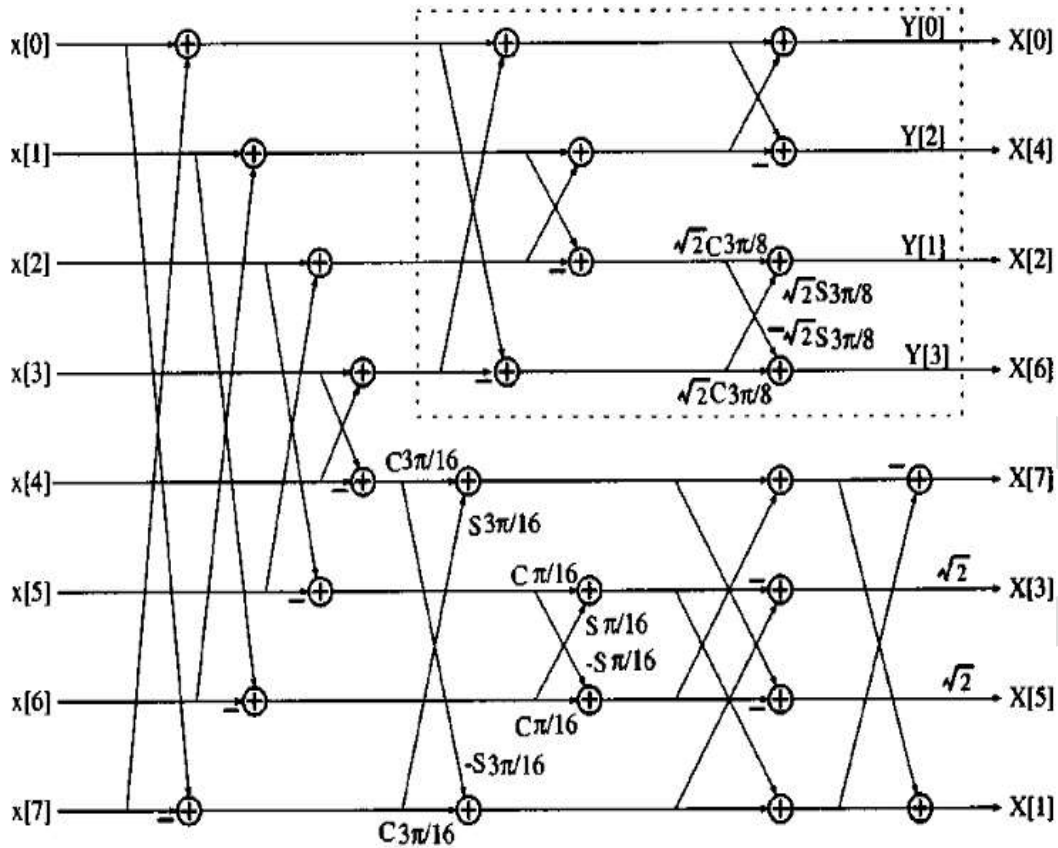


Figure 1: Loeffler's Algorithm

Quantization:

The DCT coefficient formed by using Loeffler's algorithm is given to Quantization. Dividing each DCT coefficients with Quantization value that is provided in quantization table is provided by quantization. High frequency component is not much sensitive as compare to low frequency component for human eyes. Hence, High frequency component is discarded by Quantization to reduce amount of information.

Huffman Encoding:

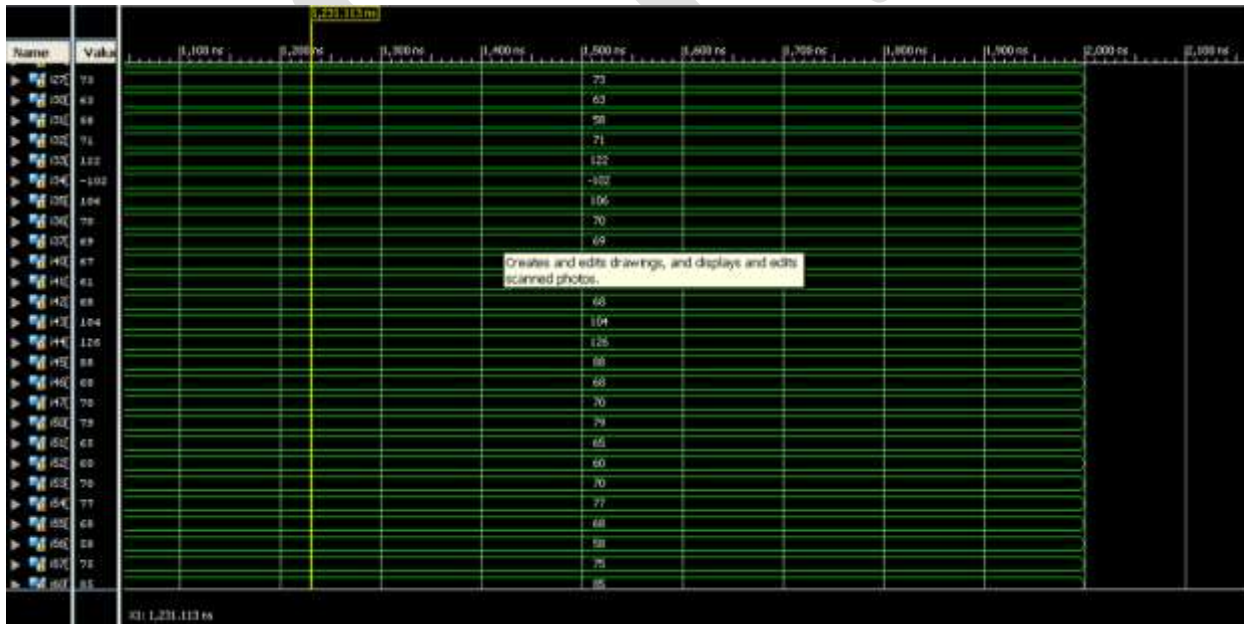
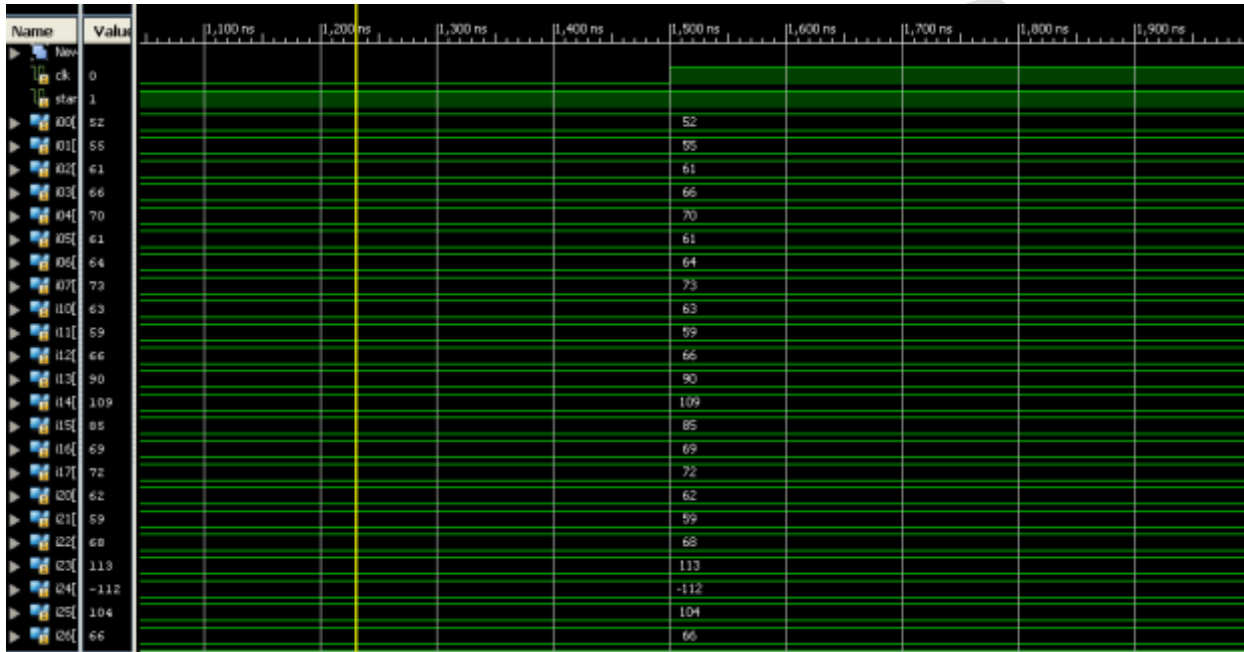
Huffman encoding is done on the quantized DCT element. The process is done by finding run/value combination of input sequence. To find this combination we have used variable length code table[7][11].VLC reduces computational complexity of a system[5].

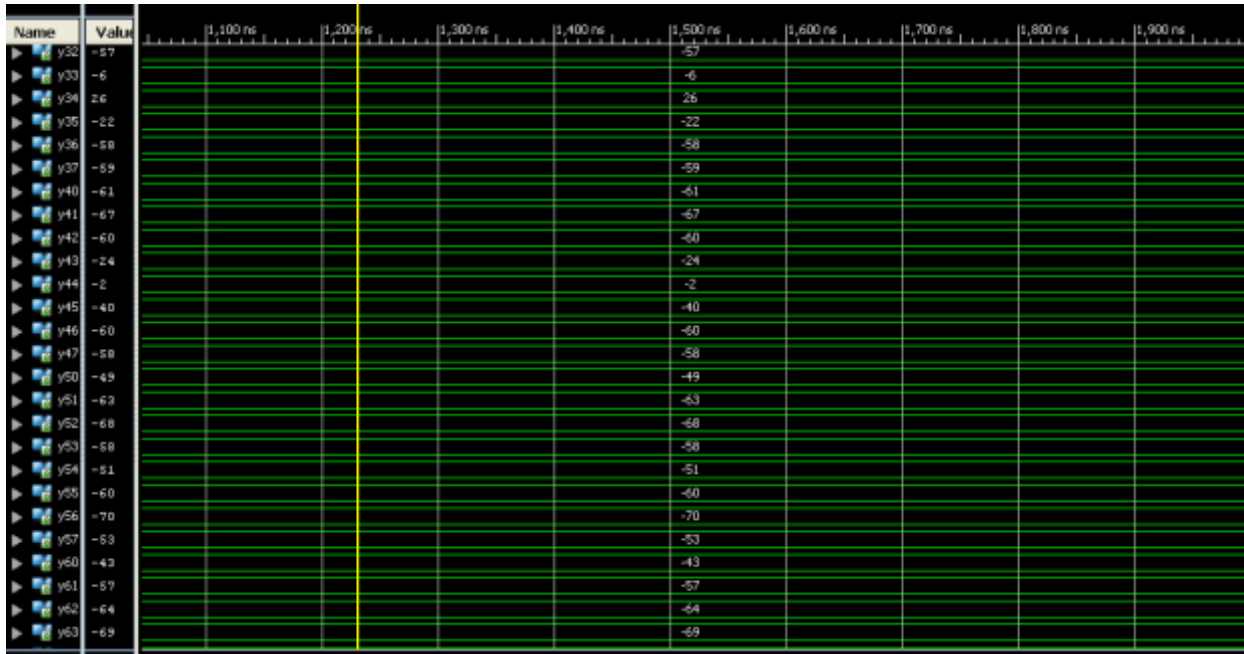
De-compression:

It is the inverse of compression. In this, decoding is also performed using VLC table. After , de-quantization is formed. Finally, IDCT is performed to obtain original image.

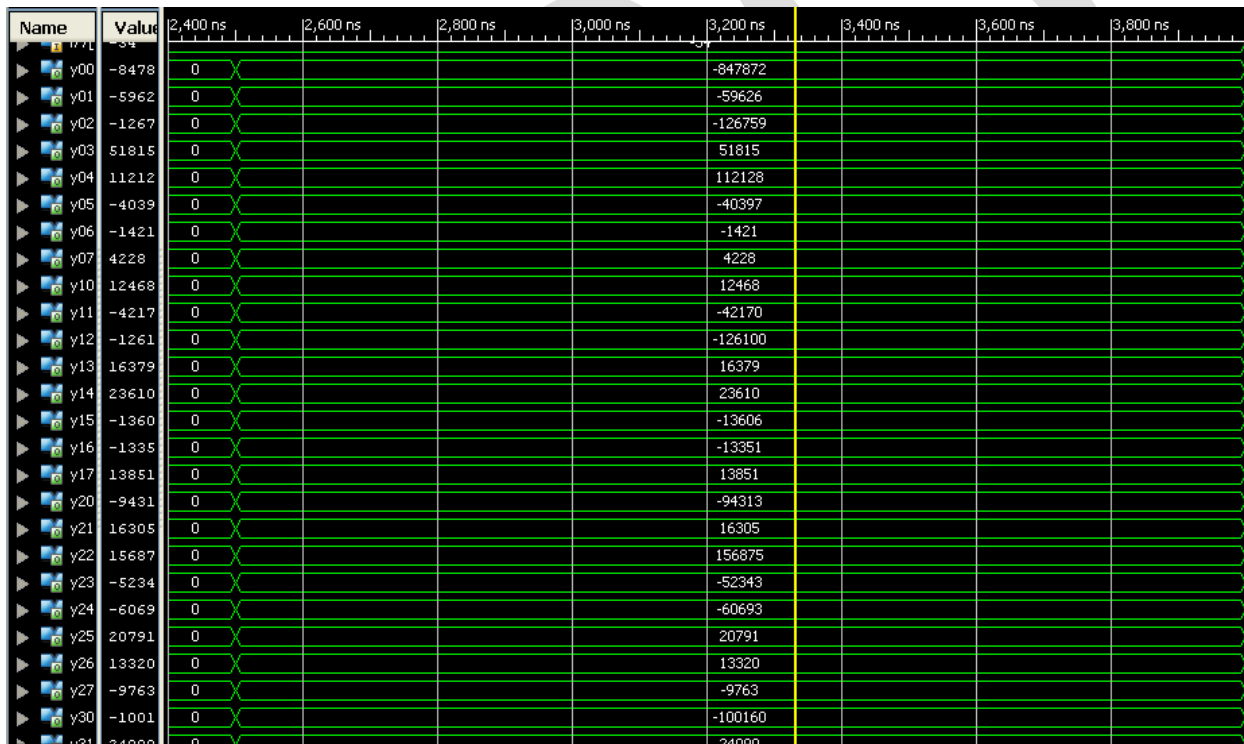
Result:

Input Of DCT Model:





Output of DCT:



Name	Value	2,400 ns	2,600 ns	2,800 ns	3,000 ns	3,200 ns	3,400 ns	3,600 ns	3,800 ns
y30	-1001	0				-100160			
y31	24090	0				24090			
y32	70141	0				70141			
y33	-2911	0				-29117			
y34	-2018	0				-20183			
y35	12681	0				12681			
y36	2847	0				2847			
y37	3082	0				3082			
y40	22016	0				22016			
y41	-1563	0				-15632			
y42	-2546	0				-25467			
y43	-4189	0				-4189			
y44	-1024	0				-1024			
y45	2801	0				2801			
y46	-9423	0				-9423			
y47	3098	0				3098			
y50	-1967	0				-19677			
y51	2874	0				2874			
y52	6951	0				6951			
y53	-6723	0				-6723			
y54	-955	0				-955			
y55	847	0				847			
y56	3719	0				3719			
y57	-812	0				-812			
y60	-5943	0				-5943			
y61	-2486	0				-2486			

Name	Value	2,400 ns	2,600 ns	2,800 ns	3,000 ns	3,200 ns	3,400 ns	3,600 ns	3,800 ns
y46	-9423	0				-9423			
y47	3098	0				3098			
y50	-1967	0				-19677			
y51	2874	0				2874			
y52	6951	0				6951			
y53	-6723	0				-6723			
y54	-955	0				-955			
y55	847	0				847			
y56	3719	0				3719			
y57	-812	0				-812			
y60	-5943	0				-5943			
y61	-2486	0				-2486			
y62	3096	0				3096			
y63	62	0				62			
y64	1779	0				1779			
y65	-7155	0				-7155			
y66	3653	0				3653			
y67	-5697	0				-5697			
y70	-2582	0				-2582			
y71	-1467	0				-1467			
y72	-1051	0				-1051			
y73	-5519	0				-5519			
y74	-176	0				-176			
y75	-812	0				-812			
y76	-1872	0				-1872			
y77	836	0				836			

Conclusion:

We have successfully implemented JPEG Algorithm using VHDL language. In this paper, we have implemented JPEG algorithm using DCT that uses Loeffler algorithm. This algorithm requires minimum number of multiplication hence reduce computational complexity. In Quantization, Division operation is replaced with shift operation. Then, Encoding is done and obtain image compression. For decompression, reverse operation is done. This whole operation can be done using VHDL language.

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