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:

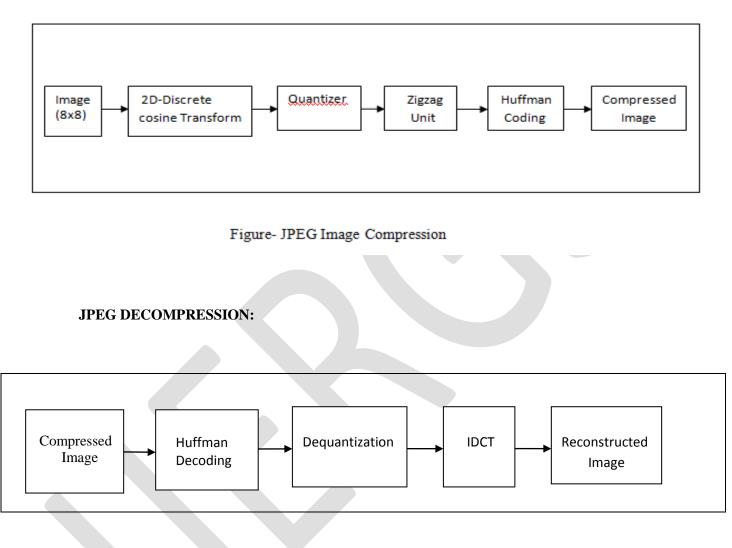


Figure-JPEG Image De-compression

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.

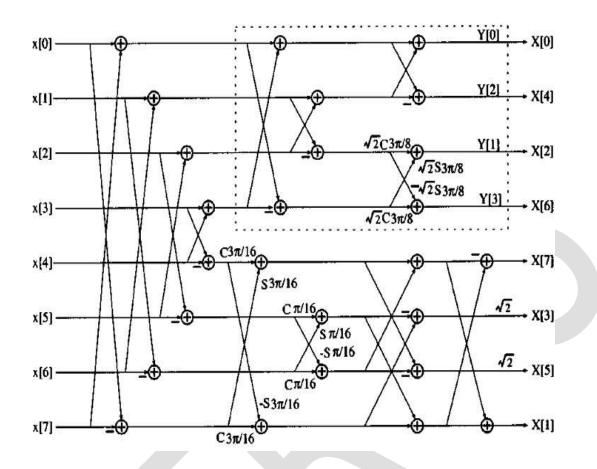


Figure 1: Loeffler's Algorithm

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:

Value	1,100 rs	1,200 ns	1,300 ns	1,400 ns	1,500 ns	1,600 ns	1,700 ns	1,000 ns	1,900 ns
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cik 0									
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11[69					59				
12[66					66				
					90				
13[90					90				
14[109									
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16[69					69				
17[72					72				
20(62					62				
21[59					59				
22(68					68				
23[113					113				
					-112				
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Name Value	1,100 ns 1,	200 rs 1,300 rs	1,400 rs	1,500 ns	1,600 ns	1,700 ns	1,800 ns	1,900 ns
▶ ₩ v33 -6				-6				
▶ ₩ v34 z6				26				
► ■ y35 -22				-22				
► ₩ y36 -58				-58				
▶ 🖏 y37 -59				-59				
▶ ₩ y40 -61				-61				
▶ 🐝 y41 -67				-67				
▶ 🖬 y42 -60				-60				
▶ 📲 y43 -z4				-24				
▶ 📲 y44 -2				-2				
▶ 📲 y45 -40				-40				
▶ 📲 y46 -60				-60				
▶ 📲 y47 -se				-58				
▶ 🌃 y50 -49				-49				
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▶ 📲 y61 -57				-57				
▶ 📲 y62 -64				-64				
▶ 📲 y63 -69				-69				

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
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🕨 📑 у02	-1267					-126759			
🕨 📑 у03	51815					51815			
🕨 📑 v04	11212					112128			
🕨 📑 у05	-4039					-40397			
🕨 📑 уОб	-1421					-1421			
🕨 📑 у07	4228					4228			
🕨 📑 y10	12468					12468			
🕨 📑 y11	-4217	ο χ				-42170			
🕨 📑 y12		0 X				-126100			
🕨 📑 y13	16379	0 X				16379			
🕨 📑 y14	23610	0 X				23610			
🕨 📑 y15	-1360	οχ				-13606			
🕨 📑 y16	-1335	οχ				-13351			
🕨 📑 y17		0 X				13851			
🕨 📑 y20	-9431	0 X				-94313			
🕨 📑 y21		0 X				16305			
🕨 📑 y22		0 X				156875			
🕨 📑 y23						-52343			
🕨 📑 y24						-60693			
🕨 📑 y25						20791			
🕨 📑 y26						13320			
🕨 📲 y27						-9763			
🍺 📑 y30						-100160			
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🖥 y31 🛛 24	090	0					24090			
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	563	0	<u> </u>				-15632			
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	723		\geq				-6723			
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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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