INTELLIGENT IMAGE ENCODING METHODOLOGY USING COVQ WITH FSS NORMS

[1]Meghana L , [2]R Jaya
[1]Student, [2] Sr. Assistant Professor
Computer Science and Engineering,
New Horizon College of Engineering, Bangalore, India

Abstract: In the image processing trade, digital image encoding and decoding are the key domain to be concerned with. The past concerns did not care about the channel optimization norms, in order that the noise and interruptions are raised more in the image oriented communications. Within this planned approach, two major algorithms are considered which provides huge support to image processing domain such as: Channel-Optimized Vector Quantization (COVQ) and Fish School Search (FSS). The dataset training principles are handled together with Codebook methods as well as channel estimations that represents the channels to be optimized. The proposed technique embeds the Fish School Search (FSS) as a Swarm Clustering Algorithm to COVQ. The planned technique embeds the Fish faculty Search (FSS) as a Swarm clump algorithmic program to COVQ. The planned system result potency is proven with results that issues a Binary symmetrical Channel (BSC) reveal the prevalence of the planned technique over typical COVQ codebook style in terms of the standard of reconstructed pictures. For all the entire system is best to perform the image encoding and decoding methodology as well as producing accurate results compare to the pat approaches. The FSS COVQ is also compared with the other image compression method called discrete cosine transform (DCT) and proved that FSS COVQ is best for image compression.

***IndexTerms* – Image compression, Fish School Search (FSS), Channel Optimized Vector Quantization (COVQ), and Discrete Cosine Transform (DCT)**

I. INTRODUCTION

Communication systems are unit extremely hooked on compression approaches due the amount of data as image, voice and video transmitted a day. In applications containing signal transmission and storage, signal compression strategies play a very important role in reducing the amount of bits required to represent a given signal. Vector Quantization (VQ) could be a compression technique that enables a high compression rate. Among many applications of VQ, one will mention compression, steganography and digital watermarking. VQ-based compression systems area unit sensitive to noisy channels, which might result in reconstructed signals with poor quality.

A relevant drawback in VQ is that the style of codebooks with strength to channel errors. During this situation, Channel- Optimized Vector division (COVQ) has been thought-about. The COVQ theme is another that takes advantage of knowledge from the supply and therefore the channel to reduce the impact of channel errors on the reconstructed signal. Within the situation of the channel, COVQ ends up in reconstructed signals with higher quality compared to those obtained by victimization standard VQ. [1]

The main aim of this paper is to design the codebook with higher compression rate for the image. A picture was compressed and transmitted over the binary symmetric channel (BSC) with totally different bit error rates (BER) and also the FSS-COVQ achieved gains up to 1.24 dB, in terms of the height signal to noise ratio (PSNR) of the reconstructed pictures, stating the prevalence of the new methodology. [1]

II. LITERATURE REVIEW

In recent years, the event and demand of multimedia system product grows progressively quick, conducive to scant information measure of network and storage of device. Therefore, the speculation of knowledge compression becomes additional vital for racing the info redundancy to save lots of additional hardware area and transmission information measure. In engineering science and knowledge theory, knowledge compression or supply writing is that the method of encrypting data exploitation of fewer bits or alternative information having units than associate degree unencoded illustration. [2]

Compression is beneficial as a result of it helps scale back the consumption of costly resources like disk area or transmission information measure. Image compression is associate degree application of knowledge compression that encodes the initial image with few bits. The objective of compression is to chop back the redundancy of the image associate degreed to store or transmit data in a cheap kind. The most goal of such system is to cut back the storage amount the maximum amount as potential, and also the decoded image displayed within the monitor is similar to the initial image the maximum amount as is. Compression writing is to store the image into bit-stream as compact as potential and to show the decoded image within the monitor as actual as potential. The diagram of the overall encryption flow of compression is given below in figure 2.1. [2]

Fig 2.1 The general encoding flow of image compression

Reduce the Correlation between Pixels is that the relationship between one pixel and its neighbor pixels is extremely high, or are able to say that the values of 1 pixel and its adjacent pixels are dreadfully related. Quantization has the target to cut back the exactness and to realize higher compression quantitative relation. Entropy Coding has the most objective of writing to realize less average length of the image. [2]

III. FISH SCHOOL SEARCH

The novel Binary Fish college search algorithmic program, developed and given during this work, was created and supported for the improvement of search algorithm: Fish college search (FSS), made-up by C. Bastos Filho and F. Lima Neto in 2007. FSS was planned to resolve search issues and it's supported the social behavior of faculties of fish. Within the FSS algorithmic program, the search area is delimited and every doable position within the search area represents a doable answer for the matter. Throughout the algorithmic program execution, every fish has its positions and weights adjusted in step with four FSS operators, namely, feeding, individual movement, collective-instinctive movement and collective-volitive movement. FSS is inherently parallel since the fitness may be evaluated for every fish one by one. Hence, it's quite appropriate for parallel implementations.

However FSS contains a number of abstractions and simplifications that are introduced to afford potency and value to the algorithmic rule. The maximum physical appearance derived from real fish faculties and are assimilated into the core of the approaches that are sounded. They're classified into 2 evident classes of behaviors as follows:

Feeding: impressed by the natural instinct of people (fish) to seek out food so as to grow robust and to be ready to breed.

Swimming: the foremost elaborate discernible behaviour utilized during this approach.

This range of swimming is classified into 3 classes: (i) individual movement, (ii) collective-instinct movement and (iii) collective volitive movement. [3] [6]

3.1 Individual movement

Individual movement happens for {every} fish within the tank at every cycle of the FSS formula. The swim direction is haphazardly chosen. On provided that the candidate endpoint resolution lies amongst the tank boundaries, the fish evaluate whether or not the food compactness there appears to be higher than at its current location. If not, or if the step-size would be thought of uphill (i.e. lying outside the tank or blocked by, say, reefs), the individual movement of the fish wouldn't occur. Presently when every individual movement, feeding would occur, as elaborated higher than.

For this movement, a parameter was outlined to work out the fish displacement within the tank known as individual step ($step_{ind}$). Every fish moves $step_{ind}$ if the original position has a lot of food than the earlier position. Actually, to incorporate a lot of randomness within the search method the individual step is increased by a random variety generated by an identical distribution within the interval [-1, 1]. During this simulation, the individual step was weakened linearly so as to supply exploitation skills in later iterations. [3][6]

$$x_i(t+1) = x_i(t) + rand(-1, 1)\, step_{ind} \quad (1)$$

3.2 Collective instinctive movement

After the individual movement, a weighted average of individual movement supported the fast success of all fish of the college is computed. This suggests that fish that had successful individual movements influence the ensuing direction of movement over the unsuccessful ones. Once the over-all way is figured out, every fish is relocated. This effort counts on the fitness analysis improvement achieved.[3]

$$I = \frac{\sum_{i=1}^{N} \Delta x_i \Delta f_i}{\sum_{i=1}^{N} \Delta f_i} \quad (2)$$

3.3 Collective volitive movement

After individual and collective-instinctive movements area unit performed, one further point adjustment remains necessary for all fish within the school: the collective-volitive movement. This movement is devised as Associate in nursing overall success/failure analysis supported the progressive weight variation of the total fish college. In alternative words, this last movement are going to be supported the general performance of the fish college within the iteration.

The explanation is as follows: if the fish college is golf shot on weight (meaning the search has been successful), the radius of the college ought to contract; if not, and it ought to dilate.[3]

$$B(t) = \frac{\sum_{i=1}^{N} x_i(t) W_i(t)}{\sum_{i=1}^{N} W_i(t)} \qquad (3)$$

IV. EXISTING SYSTEM

In the existing systems, several image coding and decryption methods area unit accessible, that performs economical process of digital pictures. However, the past systems failed to concern concerning the channel estimations, it uses Vector division (VQ) methodology to pressing the digital pictures. Vector division (VQ) may be a compression technique that enables a high compression rate. Between numerous applications of VQ, one will remark compression, Steganography and digital watermarking. VQ-based compression systems area unit sensitive to clangorous channels, which might result in reconstructed signals with poor quality. Within the case of image division, the channel noise results in interference artifacts that compromises the standard of reconstruction. A relevant downside in VQ is that the style of codebooks with hardiness to channel errors. [1]

4.1 Vector Quantization

VQ may be a block based regularly compression procedure that empowers high compression rates. In image division, blocks of pixels from the initial image area unit used as input to the quantizer system. For every input vector, nearest neighbor search is allotted, exploitation a ways live, during a set of code vectors that compose a codebook antecedently provided. Exclusively the index of the code vector highest to the input vector is transmitted or stored. To revive the image, the indexes area unit replaced by the corresponding code vectors, resulting in a degraded version of the initial image.

The goal knowledge of data compression is to characterize statistics supply data with fewest bits as accurately as attainable. There are a unit varied ways to perform knowledge compression as well as vector division (VQ). The aim of information compression is to cut back the quantity of bits being transmitted.

A disadvantage information of compression is that the compressed data is a lot of sensitive to channel noise. Compression are often lossy or lossless. [1][9][10]

4.2 COVQ codebook design

Among many codebook style algorithms, the LBG (Linde-Buzo-Gray) stands out for its large use in literature. It's an unvarying methodology wherever at every iteration the code vectors square measure recalculated to "approximate" them to the coaching set provided. The algorithmic program stop condition relies on distortion threshold. The typical distortion is delineated by the typical distance between the coaching vectors and their corresponding codevectors.[1]

The aim is to find M code vectors (codebook) for a given set of N training vectors (training set). An image is first converted into the set of X = x1; x2;:::; x_N of N training vectors in a K-dimensional Euclidean space to find a codebook C = c1; c2; …….; c_M of M code vectors. To generate the initial codebook, a picture to be compressed is rotten into a collection of non-overlapped image blocks of size 2 x 2 pixels. Store the four pixels price of all 2 x 2 blocks in memory and that we obtained initial codebook for the image as a computer file when simulating our program. Once the image blocks are vector quantal, there is a possible to occur high connection between the neighboring blocks. The comparable blocks are disregarded from the preliminary codebook to acquire the codebook which can be preserved as a optimize reference codebook. Thus, the redundancy gift within the knowledge, within the codebook are eliminated. If we tend to choose the image that contain all grey level to come up with optimize codebook that will be used for any image as optimize reference codebook. [4]

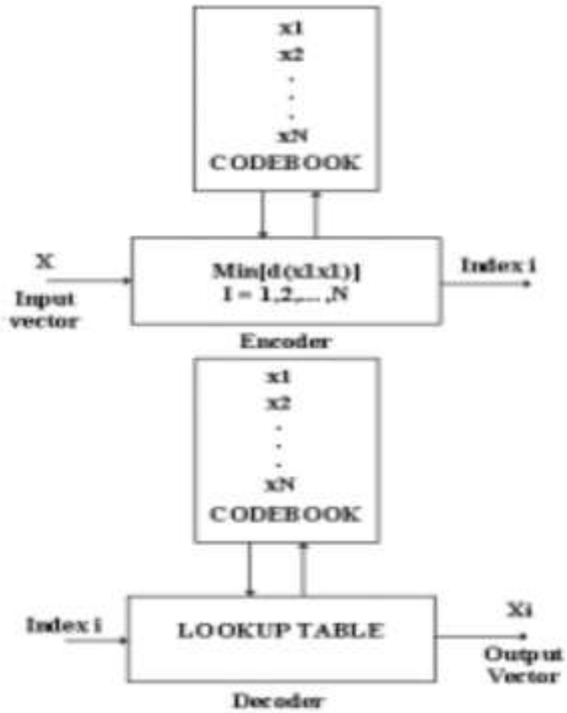

Fig 4.1 Codebook design

V. PROPOSED SYSTEM

In the planned system, beside digital compression methodology, Channel estimations area unit taken care and therefore the planned approach considers Channel Optimized Vector division (COVQ) has been thought of. The COVQ theme is another that takes advantage of knowledge from the supply and therefore the channel to attenuate the impact of channel errors on the reconstructed signal. Within the situation of uproarious channel, COVQ ends up in reconstructed signals with higher quality compared to those obtained by victimization typical VQ. COVQ is typically resolved with clump strategies because the LBG (Linde-Buzo-Gray) algorithmic program taking into consideration characteristics of the channel. The planned approach guarantees that noise free channel and vector improvement modes with correct accuracies further because the ensuing nature proves that the potency of the algorithms such as: Channel-Optimized Vector division (COVQ) and Fish faculty Search (FSS).

Considerations regarding the appliance of the FSS to COVQ during this work should be processed before describing the rule. The fitness operate for the codebook style downside employed in this paper is that the inverse of the typical distortion D, that is, 1=D. So, the smaller is that the distortion, the upper is that the fitness price. Relating to the breeding operator, at every iteration the simplest fish in terms of fitness operate selected |is chosen} to breed with the worst one and 2 alternative random selected fishes. Another necessary issue is that the LBG rule doesn't run in an exceedingly fastened range of iterations. So, it's inconceivable to use a strict decreasing linear operate to regulate the individual and volitive steps. Thus, during this paper fastened values to the individual ($step_{ind}$) and volitive ($step_{vol}$) steps were thought of. [1]

The proposed algorithm refers to each fish as a different codebook to be optimized as a possible solution. The stopping criterion is verified regarding the smaller distortion found in the current iteration, represented by D_{min}. In the end of the algorithm the respective codebook, Y_{min}, that is, the one which allows the smaller distortion, is returned as the solution to the problem. [1]

A new approach to codebook design for COVQ using a Clustering Swarm Algorithm based on Fish School Search (FSS) is introduced. The FSS-COVQ takes advantage of the possible multiple solutions provided by the FSS algorithm, a technique developed for searching in high dimensional spaces. In the present work, FSS is embedded to the LBG clustering algorithm.[1]

5.1 FSS COVQ

The FSS-COVQ may be a new approach of swarm algorithms applied to COVQ codebook style. It's an application of the FSS rule as an agglomeration swarm technique to supply increased codebooks to transmit signals over a noisy channel. Issues concerning the applying of the FSS to COVQ during this work should be processed before describing the rule. The fitness perform for the codebook style downside employed in this paper is that the inverse of the typical distortion D, that is, 1=D. So, the smaller is that the distortion, the upper is that the fitness worth. Concerning the breeding operator, at every iteration the simplest fish in terms of fitness perform designated is chosen to breed with the worst one and 2 alternative random selected fishes.

Another necessary issue is that the LBG rule doesn't run in an exceedingly fastened range of iterations. So, it's impossible to use a strict decreasing linear perform to regulate the individual and volitive steps. Thus, during this paper fastened values to the individual ($step_{ind}$) and volitive ($step_{vol}$) steps were thought-about. The projected rule refers to every fish as a special codebook to be optimized as a potential answer. The stopping criterion is verified concerning the smaller distortion found within the current iteration, described by Dmin. within the finish of the rule the several codebook, Ymin, that is, the one that permits the smaller distortion, is came back because the answer to the matter. [1]

VI. RESULTS AND DISCUSSION

This section offers an in depth description regarding the results and discussion. The code is simulated in matlab. The simulation results achieved by the projected algorithmic program. Single complete Lena picture was used with 256×256 pixels and 256 grey levels. Codebook sizes N = 256 and dimension K = 16 (that is, blocks of 4×4 pixels) were thought-about and a threshold μ = 0:001 was adopted as stop condition. COVQ codebook style was administrated for a Binary center symmetric Channel with bit error rate (BER) of 0:005. For this image, ten completely different initial codebook sets (composed by random vectors from the several coaching set) were used and also the combinatory arrangement of the parameters N and BER with FSS-COVQ and COVQ led to 1280 simulations. [1]

Concerning the FSS details, ten fishes were used for every simulation. The initial weight was 2500 and also the limit weight equals to 5000, for every fish. The individual and volitive movement steps adopted were $step_{ind}$ = 0:0001 and $step_{vol}$ = 0:01. The simulations with the COVQ technique were performed considering the codebook of the initial fish that bestowed the tiniest average distortion. The standard of the reconstructed pictures was evaluated by victimization the PSNR. The common PSNR results of ten simulations and twenty transmissions over BSC were obtained for input image, for various codebook sizes N and bit error rates of the channel.[1]

The original input image used in the project is given below in figure 6.1. The input image is of 256×256 pixels. This image is represented by A in the matlab. The compressed image is represented by B in the project. It will also have 256*256 units as the input image. But the compressed image will have different pixel values compared to the input image.

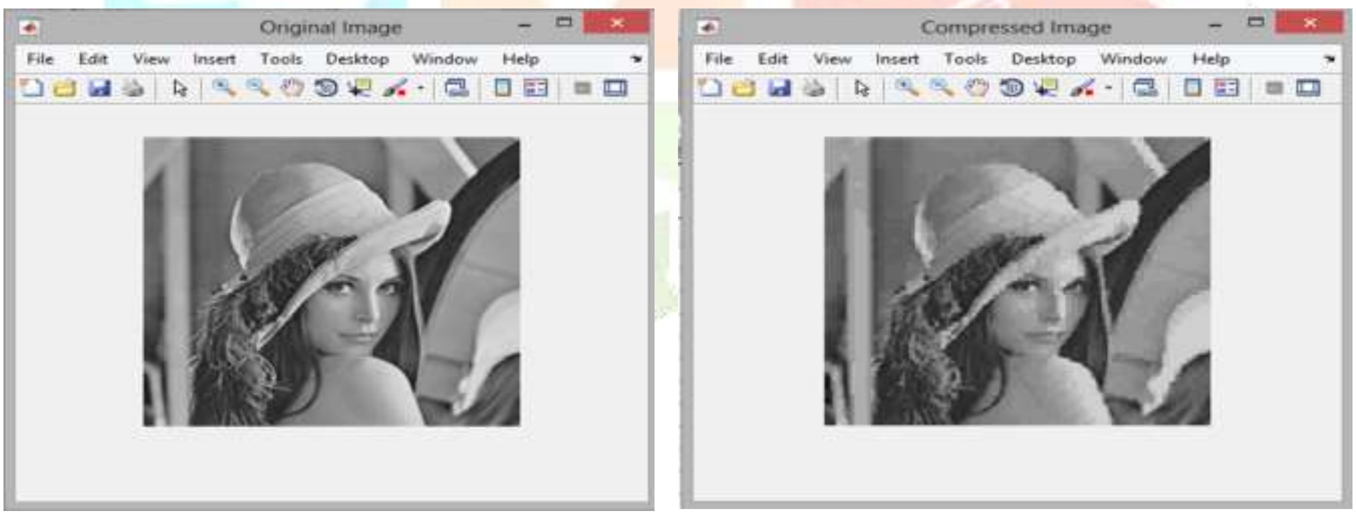

Fig 6.1 Original input image and Compressed output image

The distortion factor is obtained as 112.8185 and the previous distortion factor is obtained as 112.8196. So it is clearly said that image is been compressed correctly. The PSNR value obtained is 27.865 which is comparatively more than other algorithm value.

6.1 Comparison Model

To know about how extent the FSS COVQ is been working, I have taken up one more algorithm to compare the results with FSS COVQ. The new algorithm taken is Discrete Cosine Transform (DCT). The separate trigonometric function rework (DCT) could be a technique for changing a symbol into elementary frequency elements. It's wide employed in compression. Here we have a tendency to develop some easy functions to cypher the DCT and to compress pictures. [4][7]

DCT-based compression depends on 2 techniques to cut back the info needed to represent the image. The primary is quantization of the image's DCT coefficients; the second is entropy cryptography of the amount coefficients. The input image and compressed output image is given below in figure 6.2.

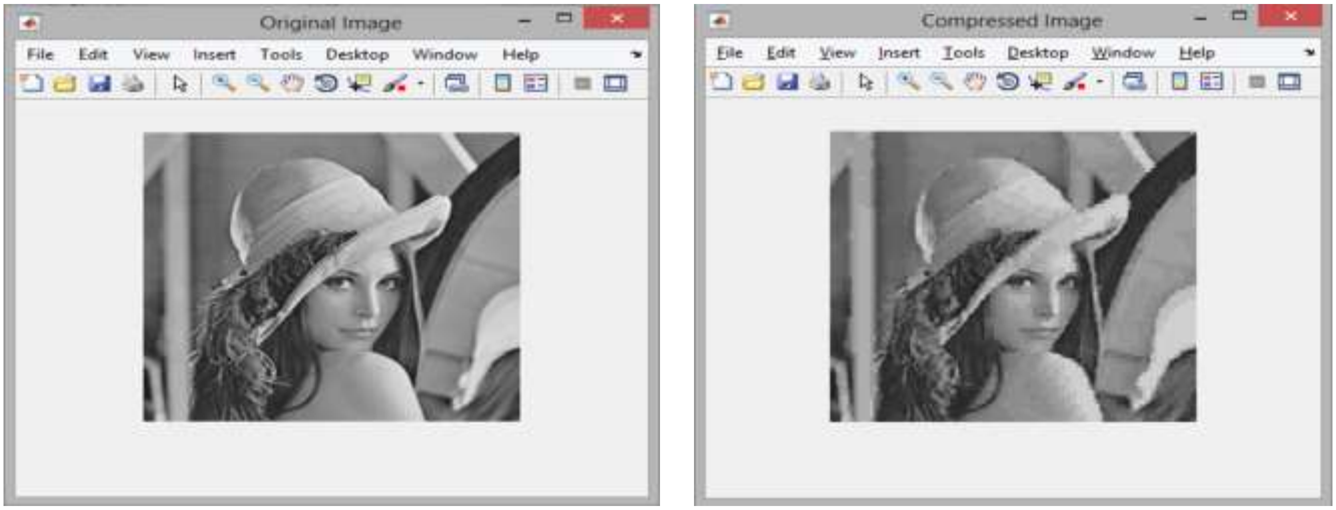

Fig 6.2 The input image and compressed image for DCT

The peak signal to noise ratio (PSNR) is obtained as 27.3708. This PSNR value is less compared to FSS COVQ. The distortion value is obtained as 120.0189 and its previous value is 119.9643. The FSS COVQ has less distortion value when compared to DCT. Even the codebook values differ largely. The distortion value should be less and PSNR value should be more for the image if it is to be said as compressed efficiently. Here the FSS COVQ is true for both the conditions and hence the FSS COVQ is efficient than DCT. The codebook design is ultimately done at the end and it is obtained in both the methods.

The codebook for FSS COVQ obtained is shown below in figure 6.3.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	20.5000	19	18	17.5000	19	19	18	20	19.5000	19	17	18	18
2	38	17	20.5000	22.5000	22.5000	17.5000	18.5000	22.5000	15.5000	17	18.5000	22	17
3	26	34	28.5000	20.5000	20.5000	24.5000	30	29.5000	17.5000	18	21	34.5000	20.5000
4	42	49.6667	40.3333	34.6667	36	49	35.3333	32.6667	34	45.3333	42.6667	29.3333	31.6667
5	17.5000	18	16.5000	17.5000	17	16.5000	17	18	19.5000	18	16	15	21.5000
6	70.3333	47.3333	42.0741	45.2222	71.4815	46.7407	42.1481	45.2593	74.5556	48.4444	40.8148	45.7407	74.0741
7	45.3333	51.3333	27.6667	27.3333	40.6667	53.6667	29.6667	27	38.6667	49	42.3333	25.6667	33.6667
8	104.3333	48.7778	39	43.3333	118.5556	49.6667	37	41.3333	132	61.7778	35.8889	41.3333	135.4444
9	15	16	16	22.5000	16	15.5000	16.5000	21	15	14.5000	16.5000	21.5000	16.5000
10	29.3333	38	75.3333	52	27.6667	26.3333	53.3333	63	28.6667	25.3333	37.6667	51.6667	30.3333
11	43	31.5000	31.5000	27.5000	46	46.5000	47	29.5000	38	54	58.5000	40	43.5000
12	15	16	16	22.5000	16	15.5000	16.5000	21	15	14.5000	16.5000	21.5000	16.5000

Fig 6.7 codebook of FSS COVQ

The codebook for DCT is given in the below figure 6.4.

A | B | codebook

256x16 double

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	75.9375	41.9375	40.8750	42.5625	50.3750	39.5625	42	43.6250	40.3125	39.3125	40.5000	43.1250	40.1875
2	23	33	38.5000	25.5000	20	24.5000	25.5000	20.5000	20	21	20	19.5000	20.5000
3	50.8545	53.4909	57.4727	59.8000	49.8364	53.0909	57.0909	58.8909	49.6727	52.8545	56.0909	57.3636	50.3273
4	40	45	37	34	42.5000	36.5000	31	28	31.5000	24.5000	22	20	28
5	23	33	38.5000	25.5000	20	24.5000	25.5000	20.5000	20	21	20	19.5000	20.5000
6	53.6667	63.6667	48.3333	33	36.3333	67	71.3333	41.3333	24.6667	47	70.3333	77	25.3333
7	17.5000	18	16.5000	17.5000	17	16.5000	17	18	19.5000	18	16	15	21.5000
8	15	16	16	22.5000	16	15.5000	16.5000	21	15	14.5000	16.5000	21.5000	16.5000
9	20	20	21.5000	30	23	21	20.5000	25.5000	23.5000	21	19.5000	22.5000	23
10	97.4211	71.9474	77.3684	84.5789	103.5263	83.4211	78.2105	91.0526	107.4211	97.7895	95.2105	116	105.3158
11	45.8571	41.3571	48.5714	70.3571	41.6429	40.5714	57.6429	96.3571	39.8571	48.4286	83.4286	126.3571	49
12	15	16	16	22.5000	16	15.5000	16.5000	21	15	14.5000	16.5000	21.5000	16.5000

Fig 6.7 codebook of DCT

From the above detailed explanation it is clarified that FSS COVQ is more efficient than discrete cosine transform (DCT). The PSNR value of FSS COVQ is more compared to DCT. The distortion values of FSS COVQ is less when compared to that of DCT. The FSS COVQ gives the better compression rate when compared to any other swarm algorithms and Fourier transforms. Ultimately the FSS COVQ is proved as the efficient algorithm for image compression methodology.

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