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ADAPTIVE OPTIMIZED ENHANCED IMAGE COMPRESSION SCHEME WITH HYBRID ENCODING

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1.1 INTRODUCTION

The AOEIC scheme generates the code book by using (Left Upper coding) LUC.The LUC method is commonly used method for VQ based image compression. In this work, Hybridized Encoding scheme is proposed to improve the computational efficiency and compression ratio.

The LUC method encodes the GRVQ table of a given image that consists of similar elements as immediate left or upper neighbours. The index table of GRVQ is encoded by using LUC achieves only significant improvement in compression rate. The Improved Locally Adaptive Coding (ILA) method was applied by GRVQ scheme for further improving compression ratio and visual quality of the figure. In this method, a replacement self-directory series list is employed rather than associate degree empty list use by standard LUC. Within the ILA method, every index is assign to the self-organizing series directory additionally encoded by their corresponding location within the list. Such distribution of the situation of associate degree index is increased by making a threshold directory that give a threshold used for every index. After that, the topmost indices be use for pressure the system flow and at the same time embedding the key bits. Although it achieves high performance in terms of compression quantitative relation, its committal to writing additionally secret writing processes has time consumption.As a result, this scheme is further improved by hybridizing ILA with LAS method named as AOEIC-HEthat improves compression ratio, embedding capacity and quality of recovery image with reduced time consumption. In this scheme, the threshold values of each index is fine-tuned to obtain the maximum frequency of index and generate legitimate codes as outputs for improving embedding capacity.

1.2 SEARCH ORDER CODING (SOC) ALGORITHM

Over the previous decades, the SOC rule is calculated for cut returned the fashionable VQ index of the representation. It one of the lossless compression theme to favor edges in the inter-block correlation internal the VQ listing area. The keysituate up of SOC rule is to recover the neighboring blocks whose VQ index is expounded with the presently processed index. The search command relies upon on the predefined ordinary search path. For a given VQ index table of an image, the index is consecutively processed in zig-zag scanning order. Whereas the SOC is performed, the at present processed VQ index is treat as a end result of the search centre. Supported the search center, the Search Path (SP) is outline as a end result of the sequence of beforehand processed indexes that go to in dextral and outward order. If a identical index is located on the SP, the present day processed index are greater compressed through practice every other code with less bits. Behind ending the tactic of everyday VQ happening the input image, the SOC rule be successful of be without delay utilized to the VQ index desk to come lower back up with a more compact index table. The advanced index table consists of two sorts of compression code simply like the SOC code and so the first Index Values (OIV) code. So, partner one-bit has to be more inner the front of each SOC code and OIV code. The recipient can separate these two differing types of code keep with the one-bit indicator. The SOC rule has the following steps:

- Step1: Discern the No.of bits d for cryptography the search order.
- Step 2:VQ index is given once input and used as a search centre.
- Step 3: Recover the SP via a similar VQ index fee once the search centre at intervals the predefined SP occurring the VQ index desk watching for the at present searched index is not a repeat SP to boot to cannot be planned with any of the SOC code, 〖(0)〗_2~ 〖(2^d-1)〗_2.
- Step 4: If the matched SP is turn out, the at present searched index is encoded with a 1-bit indicator comply with by using the equivalent SOC code. Or else, it's encoded thru the indicator comply with by using its OIV.
- Step 5: The another VQ index ought to be methodology, pass to Step2; instead, the compressed index table of an picture is given toward the decoder.

1.2.1 Left Upper Coding (LUC) Algorithm

The important goal of the LUC jointly remarked as modified SOC algorithmic program be toward improve the compression effectivity of GRVQ. or not it's additional applicable for pressure the GRVQ index desk of a given

figure. Initially, this algorithmic application is supposed to compress the first-class VQ indexes of AN figure. Among the LUC algorithmic program, the compression effectiveness of GRVQ is improved with the aid of incorporating SOC algorithmic program with GRVQ compression.

Table 1.1 illustrate a part of GRVQ index table of a figure. The differ of this index desk is 16×12 and conjointly thefluctuateof the position codebook is sixty four. Primarily based totally happening this, it's discovered to many of the indexes at some stage in this table be neighboured by indexes via the similar worth. Therefore, the excellent SOC algorithmic application be practice to the GRVQ index table of an photo to urge smart first-class compression effectiveness. On behalf of code AN index, diverse index on the predefined SP bought to be fetch and evaluate through the at presently technique index. However, the index on the SP ought to be evaluate via each and every different. Base everyday a plenty of cautious find out about on the GRVQ indexes desk of AN figure, it's located to various of the index include the comparable really worth the identical as their in AN extraordinarily line nearest left or higher neighbours. So, the tailor-made SOC algorithmic software is discovered as a result of the LUC algorithmic program.

Table 1.1 Example of 16×12 GRVQ Index Table by State Codebook Size Equalssixty four

	1	2	3	4	5	6	7	8	9	10	11	12
1	1	4	15	15	8	1	13	0	2	0	0	1
2	3	19	36	9	1	1	13	8	1	0	0	0
3	2	22	21	0	0	0	13	0	2	0	2	0
4	4	3	14	0	0	8	2	2	1	0	0	0
5	3	21	0	1	0	1	13	4	1	0	0	0
6	11	12	1	0	2	0	13	4	1	0	2	1
7	16	1	0	0	0	0	13	4	0	2	2	0
8	1	0	1	1	2	0	5	12	1	0	0	0
9	1	0	1	0	0	0	6	12	1	0	0	0
10	0	1	0	1	0	0	6	12	1	1	0	1
11	1	2	1	0	0	0	6	12	1	0	1	0
12	2	0	0	0	2	0	6	12	1	0	0	0
13	0	0	0	0	1	0	6	12	1	0	0	0
14	0	1	0	0	0	0	6	0	4	1	3	1
15	1	0	0	0	1	0	0	0	6	1	2	2
16	0	1	0	0	0	0	13	1	5	0	0	2

1.3 ADAPTIVE OPTIMIZED ENHANCED IMAGE COMPRESSION WITH LUC ENCODING (AOEIC-LUC)

The projected AOEIC-LUC theme is potency efficaciously expeditiously accustomed compress the GRVQ index table of AOEIC theme to reap higher compression efficiency. The AOEIC-LUC theme determines the most fine threshold value among that the currently processed index is alleged as a, it's straight adjoining left index is supposed as b and its at once adjoining higher index be take underneath consideration as soon as c. LUC prefer an additional one-bit indicator base on the compression schemes to separate the committal to writing capability of each block. The function of the codebook with codewords for each block of X is used to cypher the information used for every sender and receiver. Every block of the parent is changed by using the neighborcodeword it really is get from the codebook. The index cost iis save in index table 〖I〗_T.

Algorithm 1:

1. Every a inside the GRVQ index table
2. Start
3. Place Input i=a
4. If the two(a==b)
5. Cypher the a with "0" bit and finish the coding technique
6. Else if the (a==c)
7. Cypher the a with "1" bit and end the coding technique
8. Else
9. Valueof the a is unquestionable
10. End

1.4 LOCALLY ADAPTIVE CODING (LAC)

The LAC generates the codebook for associate image dynamically. The purpose of LAS is extra for compress the index desk generate with the aid of common VQ. A supplementary facts construction amongst the LAC is that the self-organizing sequence listing L that's diagrammatical the empty listing at the establishing of the LAC technique. Take into consideration the example:

- Step 1: If the List L is empty, the M=0, then the in modern times methodology word x is encoded by victimization listing L and for that reason the region of x at intervals the list is i.
- Step 2: If the x does no longer belong to L, then it's going to be encoded with the aid of M+1 concatenated with x and as a result the word x is insert at the front of the listing L. mutually if x belongs to L, then x is encoded by the location i of x at intervals the listing and x is touched to the front of the listing L.
- Step 3: By repeat the the first step and a combine of for all the phrases at intervals the different communication, a compressed conversation is achieved.

Table 1.2 shows an example of LAC scheme.

Process	Input	Self Organizing Sequence List L	Output
1	The	L=The	The
2	Car	L=Car, Th}	Car
3	On	L=On, Car, The	On
4	The	L=The, On, Car	3
5	Left	L=Left, The, On, Car	Left
6	Parks	L=Parks, Left, The, On, Car	Parks
7	By	L=By, Parks, Left, The, On, Car	By
8	The	L= The, By, Parks, Left, On, Car	4
9	Car	L=Car, the, By, Parks, Left, On	6
10	I	L=I, Car, The, By, Parks, Left, On	1
11	Left	L=Left, I, Car, The, By, Parks, On	6

When the listing of factors go to the the front of the listing L, then ensures that unremarkably used words constantly seems at the front of list L. among the methodology, they will be encoded by means of the short-code in decimal kind and conjointly the position i of x in list is moreover encoded by1+ ⌊(log_2) ⟦(i)⟧ ^⌋ bits.

1.5 ADAPTIVE OPTIMIZED ENHANCED IMAGE COMPRESSION WITH ILA ENCODING (AOEIC-ILA)

ILA is that the within your budget records concealment theme and it makes use of the mixture of LAC rule in addition as VQ. By victimization bar chart of indices vicinity and variable length secret writing, the size of the code float is reduced. Also, the grouping of the LAC rule and GRVQ improves the division of indices position. The AOEIC -ILA theme is deliberate beside LUC to improve the embedding capability and charge of secret data. Throughout this theme, a modern Self-Organizing sequence List (SOL) is use in its location of diploma empty list. intially, the ILA methodology is appointed each and each index to the SOL then each index is encoded through their many role amongst the list. To increase the division of the position of accomplice index, the sting listing is created to supply a threshold for all indices. If this threshold worth is greater than index really worth of this position, then the index well worth is shifted to top of list. It want to be noted that partner index with masses of vary of occurrences options a excessive chance to be given at the nice of the list. The very best indices unit accustomed compress the code move is to insert bits into secret data. Once collect the compressed code flow, it's going to be transmitted to the receiver. At the receiver facet, secret statistics is recovered at the equivalent GRVQ indices unit reconstructed.

Algorithm 2:

// Encoding phase

- Input: Input image ⟦ I⟧ _g, Codebook G, Threshold listing the twoT_L={t_1},and Memory List M_L and GRVQ index i.
- Output: Binary style of code glideC_s
- Acquiren index deskI_T viasecret writingI_g mistreatment GRVQ encoder
- Set SOL={0,2,…,N_size-1}, whereverN_size represents the measurement of G
- Scani from I_T
- If the (i==0)
- Code this codei by means ofe=0 ||0||sb, where ||·|| denotes the concatenation
- Else
- Obtain the position p of iinside the listing SOL
- Verify the contemporary threshold valuet
- If(p<t)
- Current index i is shifted to the second place in SOL
- Code i via the twoe=0||pc||sb
- Else if(2 ≤p≤ 4)
- Code i by e=0||pc||sb
- Else if(5 ≤p≤256)
- Encrypti by e=1||i_c·pc||sb
- End if
- End if
- Forward e to code glide C_s
- Repeat Step three to Step sixteen until all i in I_Tsquare measure processed
- Output the C_s

// decoding phase

- Input: Binary form of code floatC_s
- Output: Retrieval of twothe original image ⟦ I⟧ _g .
- Se the t SOL={0,1,…,N_size-1}
- Pick the bit b as indicator i^b from C_s and update the twoT_L
- If(i^b==0)
- Place the pof i is from one to four
- Browse the i^b of eight bits from C_s
- If the (⟦b_ ⟧ _1 of i^b==0)
- i = 0
- Insert the twoi to ⟦I_⟧ _T
- Else
- Retrieve the two computer and alter the computer to decimal really worthp
- If the (p<t)
- Then i is shifted from p to second place of SOL
- insert i to I_T
- End if
- End if
- Else if region(i^b==1)
- If the pof i is from five to 256 and take next two bits as i^b'

- If the (i^b==00)
- Take the after 3 bits, retrieve computer and regulate laptop to decimal reallyworthp
- Then i is that the well worth with p in SOL
- insert i to I_T
- If the (i^b'==01)
- Take succeeding 4 bits, retrieve laptop and alterpc to decimal really worthp
- Move the Step twenty and twenty one
- If the(i^b'==10)
- Take the subsequently 5 bits, retrieve laptop and modify laptop to decimal value p
- Move the twenty and twenty one
- If the (i^b'==11)
- Take the wheneight bits, retrieve computer and tradecomputer to decimal worthp
- Move to Step twenty and twenty one
- Repeat the Step twenty to thirtyuntill all the bits bof twoC_sare method.
- Within the embedding and extract rule, pcdenotes true code and sb denotes the key bits, i^bdenotes true code and sb denotes the key bits, I_Tis achieved. On the highest metric system from the sender, the receiver perform the image decompression method. Though the GRVQ provide a hyperbolic results in terms of the embedding capability, the compression rate of the key information isn't improved.

1.6 LOCALLY ADAPTIVE DATA COMPRESSION SCHEME (LAS)

In LAS, a self-organizing consecutive list is used to proceed these days processed symbols. By use the move-to-front heuristic, there is accomplice degree sincere likelihood to technique every photo that is among the the front position of the list. To cipher a codeword w, the LAS decoder finds its role (p) among the list. If it's found, then a prefix code for p is generated and sent to the receiver. The receiver has the equal list at that time; it's going to collect w in position p of the list. each the sender and receiver have to be compelled to go w to the the front of the list. Then, check whether or no longer or now not the w is present amongst the list, if it is not among the list then a prefix code of (l+1) ought to be despatched to the receiver, the place l denotes this dimension of the listing observe through w in raw kind. Every sender and receiver want to insert w to the the front of the listing for this reason shift the different words at intervals the list to the rear issue of the list by using one. If the list is occupied before insertion, the ultimate phrase rectangular measured deleted. Each entire number (num≥1) wishes log_2 num +1 bits or its illustration. a approach to cipher companion diploma complete quantity range is to precede num with log_2 numzeros. As accomplice degree example, numbers from one to seven square measure encoded by one, 010, 011, 00100,00101,00101,00110 and 00111 severally.

1.7 ADAPTIVE OPTIMIZED ENHANCED IMAGE COMPRESSION WITH HYBRID ENCODING (AOEIC-HE)

In the LAS, SOL handles the listing of freshly processed index. The index unit to be processed, it's gift interior the preliminary function of SOL. Embedding every index i is analyse supported the frequency f. the subsequent three instances ought to be thinking of sorting out the quantity of encryption methods in which. The 3 cases lean as follows:If the (f==0)

One way to exists for codingi and no embedding of data

- If the (0 <f <t)
  2.1 LAS coding using every functionp of i in SOL or
  2.2 Assume thef+1approachesin which duringto the code i.
- If(f ==t)
  LAS codingusage of each and every position t in SOL

Algorithm 3:

// compression and encoding Phase

- Input: input image 〖 I〗 _g, Codebook G, Threshold list T_L={t_1}, Memory List M_L and two GRVQ index i.
- Output: compressed code stream C_s
- Place the I_T' = Hilbert-curve-scan (I_T)
- Set the quantity of indices of twoI_T=N
- Declare the earliest byte of 〖 D〗 _s=d_s1
- Wheras(i≤N)
- i_i = The subsequent fee of index from I_T'
- P = position of (ni + 1) index in SOL
- PlaceS=P_size
- Range of encoded means, Wi = min (t, P+1)
- Then the quantity between zero to Wi – 1 is encoded by,
- ni= 〖 d〗 _sk two mod Wi
- d_sk = 〖 d〗 _sk div Wi
- If the (f =0 || ni= f) two // case 1 and case 2.2
- Concatenate measurement of SOL with i_i to C_s
- Insert i_i to the front of SOL
- Else
- P = position of (ni + 1) index in SOL two
- Concatenate P to C_s
- Shift the part in P to the front of SOL
- End
- If (i_i≤256)
- Visit Algorithmicapplication two from Step four to seveteen
- End while
- LAS the compressed code C_s is obtained

//decoding and decompression phase

- Input: LAS compressed codeC_s, dimension size N_size of codebook G, Threshold t
- Output: Decoded I_T
- Whereas(input C_s wasn’t processed)

- P = equivalent whole quantity of prefix code whenC_s
- If (P = measurement of SOL) two
- Flag = 0
- Take N_size bits from C_s as i_i
- Else two
- Flag = 1
- i_i =The part in role P of SOL
- P = all p of i in SOL
- S = Psize
- Wi = min (t, P+1)
- If the two (flag ==0)
- ni = S
- Insert i_i to the front of SOL
- Else
- ni = part of (ni + 1) in P
- Shift the part in P to the front of SOL
- End if
- If (i_i two≤256)
- Attend algorithm rule 2 from step 13 to step 20
- End if
- End while
- I_T = The Hilbert-curve-reverse-scan (I_T')
- Output the decoded I_Ttwo
- The reconstruction of the index table from metric machine of weights and measures is done original image. Thus, the AOEIC-HE enhances each and every compression relation and reduced time consumption.

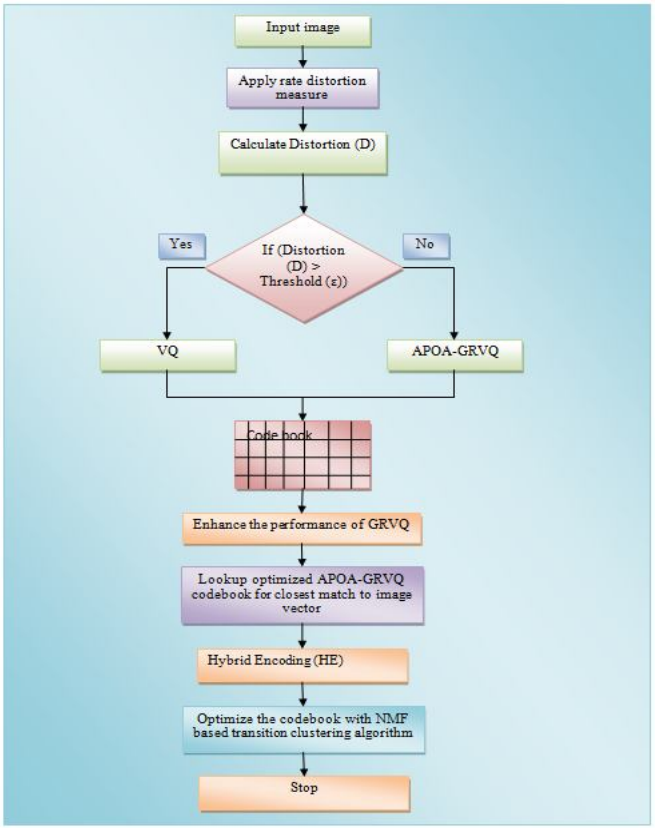

Figure 1.1 Architecture Diagram of AOEIC-HE

1.8 PERFORMANCE EVALUATION

In this section, the experimental result's given for the planned AOEIC-LUC, AOEIC-ILA and AOEIC-HE subject matters in contrast with the AOEIC scheme. Simulations are carried out victimization MATLAB2014a on UCID. The UCID dataset has 1338 uncompressed row photos on a range of subjects collectively with the herbal scenes, manmade objects. Additionally, the efficiency of the deliberate schemes is evaluated in phrases of a number of performance metrics for Family, Nature and Medical pictures.

1.8.1 Compression Ratio

Table 7.3 suggests the evaluation of overall performance metrics of planned topics and present AOEIC scheme three definitely exceptional snap shots Family, Nature and Medical snap shots in terms of Compression Ratio (CR), Peak-Signal to Noise Ratio (PSNR), Structural Similarity(SSIM) and Bit Rate (BR).Table 1.3 Comparison of the Compression Ratio for family, nature and medical image

Images / Method	AOEIC	AOEIC -LUC	AOEIC -ILA	AOEIC -HE
Family	48.9234	49.378	49.98	50.1357
Nature	49.1182	49.254	49.749	49.9786
Medical	48.9506	50.1232	50.3245	50.9506

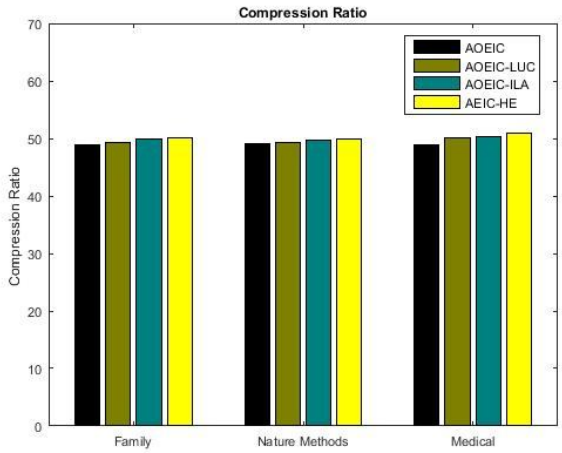

Figure 1.3 Comparison of Compression Ratio

Fig 1.3 indicates the comparison effects of present APOA-GRVQ technique with the deliberate AOIC and AOEIC strategies in conditions of compression quantitative relation. X axis is in use as different compression strategies and Y axis is in use as compression quantitative relation in share. From the chart the planned AOEIC technique presents higher excessive compression quantitative relation for family, nature and scientific image.

1.8.2 Structure Similarity

Structural similarity is employed to calculate the human sensory system, that mixes the structure, luminosity and distinction statistics for verify the visual best of decompressed image.

Table 1.2 Comparison of structure similarity for family, nature and medical image

Images / Method	AOIEC	AOEIC -LUC	AOEIC -ILA	AOIEC-HE
Family	0.9270	0.9321	0.9452	0.9745
Nature	0.9282	0.9312	0.9423	0.9582
Medical	0.9279	0.9345	0.9579	0.9779

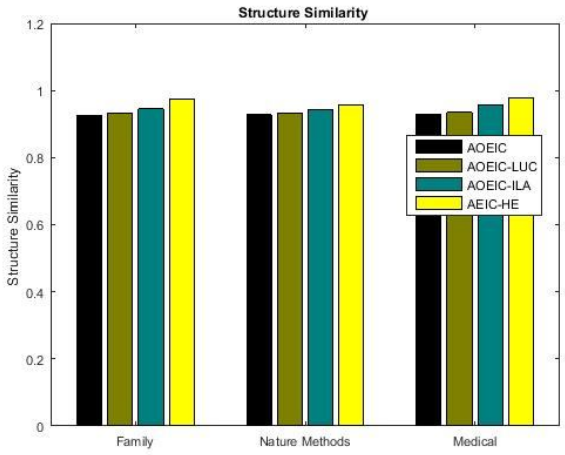

Figure 6.4 Comparison of Structure Similarity

Fig1.4 indicates the assessment outcomes of current AOEIC method with deliberate AOIC-LUC, AOEIC-ILA and AOEIC-HE methods in prerequisites of structure similarity. X axis is in use as several compression approaches and Y axis is in use as shape similarity.From the chart the deliberate AOEIC HE technique provides higher excessive structure similarity for family, nature and scientific image.

1.8.3 Peak Signal Noise Ratio (PSNR)

The PSNR is measured with the aid of the popular between the preliminary and consequently the compressed image. the higher PSNR, fee represents the first-class high-quality of the decompressed image.

PSNR (dB) = 10 log_10 〖(R^2/MSE〗)

R is the peak pixel values of input image.MSE is mean square error between the input and decompressed image.

Table 1.3 Comparison of the Peak Signal Noise Ratio for family, nature and medical image

Images / Method	AOEIC	AOEIC-LUC	AOEIC-ILA	AOEIC-HE
Family	48.0937	48.4564	49.2336	49.3223
Nature	48.3219	48.9654	49.1245	49.5465
Medical	48.2378	49.234	49.7665	50.2045

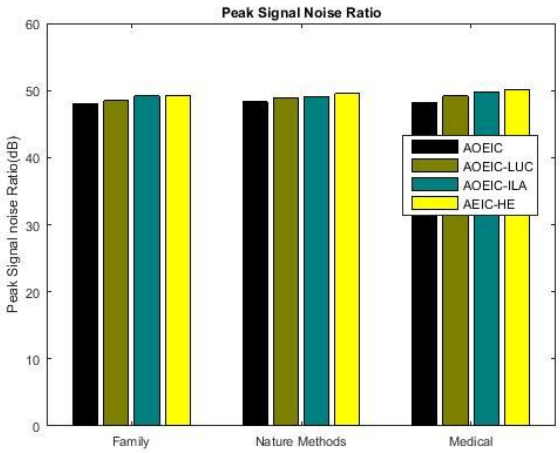

Figure 1.5 Comparison of Peak Signal Noise Ratio

Fig 1.5 shows the evaluation consequences of existing AOEIC methodology with projected AOIC-LUC, AOEIC-ILA and AOEIC-HE strategies in conditions of top sign noise magnitude relation. X axis is in use as several compression techniques and Y axis is in use as peak signal noise magnitude relation values. From the chart, the projected AOEIC-HE methodology presents extended excessive height signal noise magnitude relation for family, nature and clinical image.

1.8.4Bit Rate (kb/s)

Amount of expertise approach in a very glorious time is termed as Bit rate. The measuring of bit price is bits per second, kilobits per second, or megabits per second.

Table 1.4 Comparison ofthe Bit Rate for family, nature and medical image

Images / Method	AOEIC	AOEIC-LUC	AOEIC-ILA	AOEIC-HE
Family	2.5154	2.4235	2.3567	2.1341
Nature	2.5002	2.3921	2.2988	2.2172
Medical	2.5166	2.4376	2.3987	2.2131

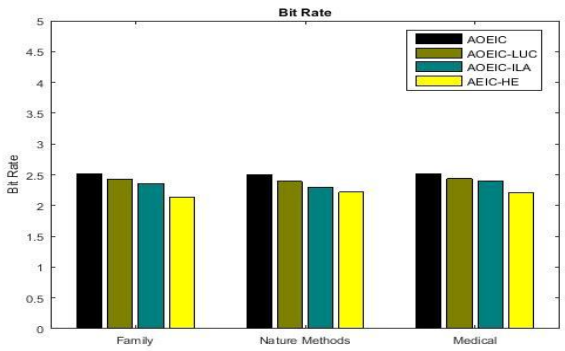

Figure 1.6 Comparison of the Bit Rate

Fig 1.6 exhibit the similarity outcomes of current AOIC-LUC, AOEIC-ILA and AOEIC-HE ways in phrases of Bit Rate. X axis is in use as various compression methods and Y axis is in use as Bit price values. From the chart the planned AOEIC-HE methodology affords expanded high bit price for family, nature and scientific image.

1.9 CHAPTER SUMMARY

This chapter, AOEIC-HE theme is deliberate to decorate the compression quantitative relation, embedded functionality and excellence of the recovered photograph with decreased time consumption. Initially, LUC methodology is delivered with AOEIC theme for stress the GRVQ desk of a picture that consists of comparable parts as instantaneous left or greater neighbours. The GRVQ indexes rectangular measure compressed by means of LUC. to reinforce the embedding capability, ILA is applied as a substitute than LUC in the course of which the distribution of the position of each and every index in GRVQ desk is expanded by using a threshold list. Then, the upmost indices square measure use to compress the code flow and plant the key bits. Moreover, AOEIC-HE is deliberate through hybridisation ILA with LAS methodology to fine-tune the facet rate of every index provided by means of the edge list that generates professional codes as outputs for up embedding capability. It exhibit of the deliberate algorithmic program is evaluated through Compression Ratio (CR), Peak-Signal to Noise Ratio (PSNR), Structural Similarity SSIM) and Bit Rate (BR).

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