SELECTIVE SCAN FOR NEAR REVERSIBLE DATA HIDING USING DCT

Reference NO. IJME 2516, DOI: 10.5750/sijme.v167iA2(S).2516

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KEY DATES: Submission date: 15.09.2024; Final acceptance date: 01.03.2025; Published date: 30.04.2025

SUMMARY

Data Hiding is now a major area of study due to the internet's and multimedia technologies' amazing growth. Since data digitization and communication networking have advanced over the past ten years, protecting data transmitted over the internet has become a major concern. Numerous applications in steganography and watermarking find it desirable when data is integrated into multimedia cover content, such as audio, video, and photos. Watermarking will be used for copyright protection, while steganography will be chosen for encrypted communication. Even when the embedded data has been extracted, irreparable harm to the cover media is usually unavoidable with such techniques. The perfect restoration of the cover medium is necessary for some applications, including remote sensing, military mapping, geographic mapping, and medical diagnostics. Therefore, in sensitive applications like medical diagnosis, reversible data hiding techniques are used to restore the cover media without distortion. Confidential information, the content owner's identity, cover content details, etc., are examples of the data that may be included. The data hiding techniques will be shown in order to determine the trade-off between embedding capacity and visual quality. The frequency coefficients of the cover image are changed by the frequency domain techniques. According to experimental results, the recommended procedures perform better than the current approaches for standard QCIF encoded videos and standard grayscale images utilizing the USC SIPI image database. The suggested method considers the information of the cover content during data embedding and provides a trade-off between visual quality and embedding capacity.

KEY WORDS: DCT, Near reversible, Selective scan, Embedding, Frequency domain

1. INTRODUCTION

In order to apprehend a digital image, one should recognize what is considered when a "digital image" is displayed. The digital image in the laptop is surely a records shape in which every pixel or image aspect is represented by using a number or code. This code tells what coloration that pixel. Each pixel may be considered as a discrete pattern of a continuous actual image. We have to talk about the one-of-a-kind digital imaging strategies that have been used conventionally and their suitability. A digital photo may also be created with a digital camera, portray or drawing software, 3D rendering application, or web page or slide scanner. The digital digital camera can without problems recognize the digital image. A digital image is created with the useful resource of a digital digital camera as depicted in Figure 1. In this configuration, the camera is pointed at a scene, and mild rays from the scene are centered thru a lens onto the camera's image plane. A grid-like structure contains the camera's photo aircraft made out of image sensors the place each sensor represents a pixel in the produced image. Voltage produced by means of each sensor is at once proportional to the illumination depth of the incident light. The voltage is then transformed into binary code by way of an analog-to-digital conversion circuit for storage in a pc reminiscence phone and in the cost of every pixel as some shape of binary code. A 2D array of pixel values can be used as the preferred shape for storage that organizes in reminiscence as a regular grid corresponding to the row and column indices at which the image sensor receives every pixel's value. Each image sensor has a finite subject of view, as proven with the aid of the circles in Figure 1

The mild that strikes its floor is represented via the weighted common indicated by using the reading. Each pixel in reality represents the mild distribution situated round the pattern factor over a small area, which is captured by means of a single factor on the camera's photo plane. To provide an explanation for how the weighted common is derived over the pattern area, a weighting characteristic acknowledged as the factor unfold feature is utilized. As proven in Figure 2, the plan illustrates the form encountered in a digital digicam via sampling through a factor unfold function.

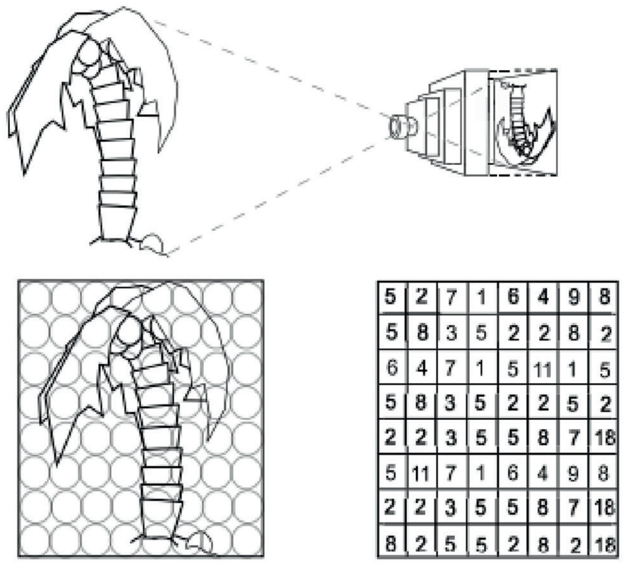

Figure 1. Establishing a continuous two-dimensional image of a scene

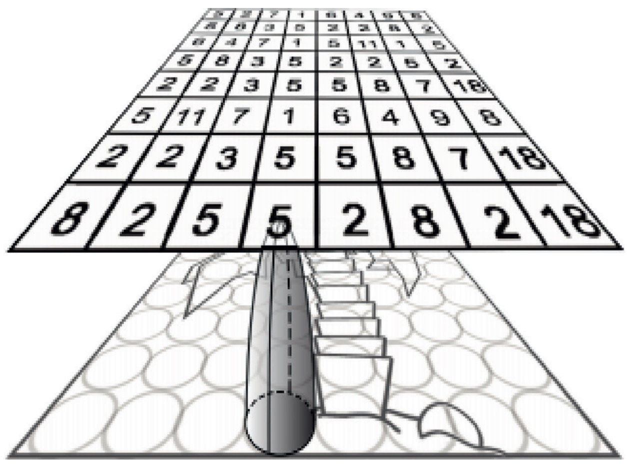

Figure 2. A point-spread function is used for the sampling process

The digital photo is of little use if it can not be seen via the computer. It is quintessential to have a reconstruction procedure in order to invert the sampling process. This is finished so that the discretely sampled photo may also be rebuilt from a actual non-stop scene. This technique need to be utilised in order to seriously change the discrete photo samples into a continuous photograph that is appropriate for output on a machine such as a CRT or LCD for viewing purposes, or a printer or film recorder for hardcopy purposes. There is additionally the opportunity of comprehending this manner by means of capability of the concept of the factor unfold function. Imagine every sample, or pixel, being despatched lower back to the authentic source. Each sample is being fed again via a factor unfold feature in the digital image, which distributes the pixel value throughout a restricted region. This is completed in order to reap the favoured effect.

2. EXISTING SCHEME

As an input, the reference photograph is acquired from the present system. The reference photograph is then divided into 8×8 blocks of depth values. Each block is then subjected to a 2-dimensional discrete cosine radically change (DCT), which is utilized to every block. With the help of an 8×8 block quantization table, the division of every block is accomplished. In the method of embedding, Sagar et al. proposed a method [1] that made use of the logarithmic function. Although this format is succesful of accomplishing reversibility and massive capacity, it falls quick in phrases of good visual quality, which is some thing that wishes to be addressed. For embedding, the existing method takes into account all of the AC coefficients that are now not zero. As a end result of this low PSNR that is achieved, the visible quality is relatively diminished. [2][3].

3. PROPOSED SCHEME

Each and every data concealing system must have key characteristics, including the visual quality, the resilience, and the hiding capacity. The changes that occur among the three features vary precisely depending on the requirements of the user and the application domains that are associated with each application. It is necessary to have a method known as data concealing (near reversible) in order to fulfil the requirements of applications such as copyright protection of remote sensing photos [4]. However, it is possible to accomplish this by providing a polynomial-based near reversible system that makes use of DCT. This is due to the fact the complete focal point of this endeavour is on the visible quality. For the reason of engaging in this objective, especially in phrases of PSNR [5–7] the visual pleasant wants to be enhanced. The low frequency, or non-zero coefficients of the discrete cosine transform (DCT), are being unnoticed in order to make bigger the PSNR values. As a final result of this, there is a reduce in embedding capacity, and the NK is almost identical, however the PSNR is nevertheless excellent, indicating that the visible quality is maintained. We do no longer take into consideration low frequency when the multimedia content material is now not clear; rather, we focus on center frequency and excessive frequency of the multimedia content [8–9]. We are in a position to take a look at a reduce in visual best if low frequency factors are adjusted. the selective scan method is utilised in Figure three in order to enhance the visible quality. The scan List of Selective we are evaluating from the quantified DCT values from i = 18. Figure 3 shows Selective scan process.

The selective scanning process involves from the mid frequency component of an 8 × 8 block. It is recommended to use the scan, and it is applied to non-uniform quantisation of N X N DCT [10] coefficients prior to run length coding. One of the benefits of this construction is that it allows for

0	1	2	3	4	5	6	7
8	9	10	11	12	12	14	15
16	17	18	19	20	21	22	23
24	25	26	27	28	29	30	31
32	33	34	35	36	37	38	39
40	41	42	43	44	45	46	47
48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63

AQ3

Figure 3. Selective scan process

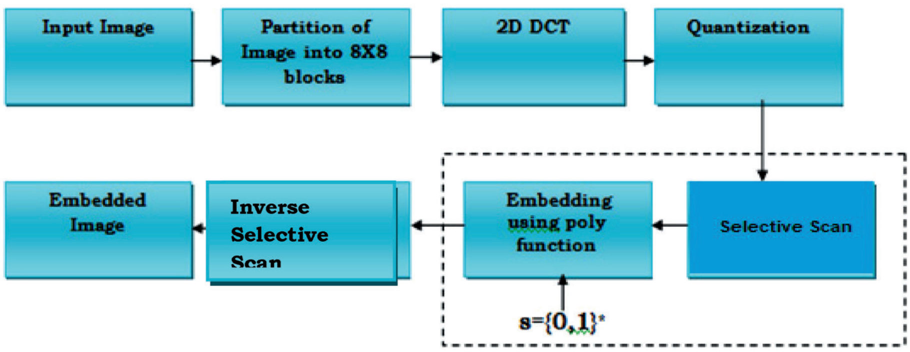

Figure 4. Embedding process

efficient coding of the coefficients of the discrete cosine transform (DCT) during the Selective scans. The results of this scanning are very good for applications involving lossless compression. DCT compression is finished once a selective ordering has been completed. For the purpose of achieving the aforementioned objective, which is an enhancement in visual quality, a mathematical function that is based on polynomials is utilised. For the purpose of input, the input image is captured and partitioned into 8 x 8 intensity blocks. Additionally, a two-dimensional discrete cosine transform (DCT) is implemented on each block of the partitioned input image. An 8 x 8 block quantisation table is used to separate each block into its constituent parts. We are required to take into consideration the quantised DCT values beginning with i = 18 for each block in the selective scan method, as well as in the selective scanned list. As illustrated in Figure 4, the embedding process involves the incorporation of data into all Non-Zero DCT coefficients. This means that the data is only incorporated into a block when the no. of non-zero DCT coefficients in that block is larger than zero.

3.1 DATA EMBEDDING PROCEDURE

The data is contained in every block, with the exception of the blocks that are equal to zero, and in every DCT Coefficient pixel that is not zero. The watermarked coefficients are kept in the design, which is intended to improve the visual quality by limiting the alterations made to the original coefficients. This would bring the value of the watermarked coefficients that are more closely tied to their original values. To keep the secret information hidden, the DCT coefficients are changed using a polynomial function.

Algorithm: Embedding

1. Take an input image *I* and
2. Partition I using DCT I $\rightarrow \{B_1, B_2, \ldots. B_l\}$

   For each $B_j \in I$, where $1 \leq j \leq 8$

   (a) Quantize the DCT coefficients B_j in as below.

   for $i_1 \leftarrow 1$ to 8 do

   for $i_2 \leftarrow 1$ to 8 do

$C_j (i_1, i_2) = B_j (i_1, i_2)/Q(i_1, i_2)$;

end

end

3. Selective Scan applied

Once the matrix has been converted to row or column vectorization, compute T as indicated in function (1). Change all of the non-zero AC coefficients and use function (2) to incorporate the data if T > 0. Let C_j be the resulting block.

4. Inverse Selective Scan is applied
5. Combine all the Cj blocks into $I = \{C_1, C_2, \ldots C_l\}$.
6. For all the blocks repeat step 1 to step 5.

$$T = \sum_{j=18}^{64} c_j \quad (1)$$

$$C \begin{cases} = \sqrt{(5c^2 - 3c + 6)} * 0.44 \text{ if } s = 0 \\ \sqrt{(5c^2 - 3c + 6)} * 0.3 \text{ if } s = 1 \end{cases} \quad (2)$$

Where c is the non-zero DCT Coefficient, S is the secret bit and Em be the modified version of c. Images that are 512 × 512 and greyscale are fed into the embedding method. Then, the quantised coefficient is found on each image by using DCT and then quantisation. After that, the secret data will be hidden using the selective scan in quantised coefficients. Third example: As shown in Table 1, the embedded algorithm is used on an 8 × 8 part of the cover image. To work with 8 × 8 matrices as data, first make the DCT matrix. Then, use quantization on an 8 × 8 grid, and do the same thing for all 512 × 512 greyscale sub images. The secret data is hidden after the data is quantised into quantised coefficients. A selective scan is used to pick out the quantised values. After that, de-quantization is done, and inverse DCT is done on the inserted coefficients. In this process, the stego-object pixels are made. What values into the 8 × 8 block, as shown in Table 1.

To create DCT, the original block is "levelled off" by removing 128 from each entry, as shown in Table 2. This allows the DCT to be constructed for pixel values between from –128 to 127.

Following the application of DCT to the coefficients of the 8 × 8 matrix, they are displayed in Table 3 as the resultant 8 × 8 matrix. Table 4 displays the quantised DCT coefficients 8 × 8 matrix that was produced as a result of the quantisation process applied to the DCT coefficients.Following the embedding of confidential information on quantised coefficients of an 8 × 8 block, the resultant embedded matrix is displayed using Table 5. The de-quantization and inverse discrete cosine transform functions are applied to embedded 8 × 8 blocks, as demonstrated in Table 6. The no. of bits embedded depends on the selective scan, the point from where the scan started, as shown in Table 5. and 6. It follows that the distortion is comparable to the current system when it comes to embedding secret data using the NRDH P technique, but it is sufficiently powerful when it comes to resisting compression. In addition, the cover content is the only determinant of the quantization in the embedding process.

Where is the non-zero DCT Coefficient, the secret bit be S and Em be the modified version of c.

3.2 EXTRACTION PROCESS

When the Secret bit S = 0 or 1, the extraction process restores [18] the generated DCT coefficients by extracting the image

Extraction Algrithm

1. obtain an watermarked input image (I)
2. Extract C_j from $I \leftarrow \{C_1, C_2, \ldots C_l\}$.

Table 1. Input 8 × 8 matrix

159	155	140	146	148	159	164	159
157	157	148	155	162	164	159	157
159	150	157	159	157	157	157	162
157	159	159	164	157	157	159	157
155	159	162	159	155	159	159	157
162	159	157	155	159	162	155	155
164	162	159	162	159	159	159	155
159	157	162	159	159	157	157	157

Table 2. leveled off 8 × 8 block

32	27	12	18	20	31	36	31
29	28	20	27	34	36	31	29
32	22	29	31	29	29	29	34
29	31	31	36	29	29	31	29
28	31	33	31	28	31	31	29
35	31	28	27	31	34	27	27
36	34	31	34	31	31	31	27
31	29	34	31	31	29	29	29

Table 3. 8 × 8 block after DCT

238.37	–2.30	3.22	7.19	0.12	2.59	–0.38	–3.40
–9.70	–12.62	8.14	7.17	1.33	–0.33	–3.45	–3.62
–4.86	–3.68	7.57	8.60	0.46	–1.27	–2.829	–0.17
–4.10	–0.25	7.11	7.82	–5.59	–2.37	–2.40	–2.78
–3.52	–1.58	2.91	–5.22	–4.37	2.55	–2.42	–0.59
0.21	2.30	4.28	–0.67	1.64	4.27	–2.73	–1.83
–5.21	–1.99	4.42	–0.56	2.10	0.81	4.92	2.20
–0.88	–1.42	2.60	–4.07	–0.21	3.15	1.68	1.02

Table 4. 8 × 8 block of DCT quantized

17	0	0	0	0	0	0	0
–1	–1	1	1	0	0	0	0
0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Table 5. 8 × 8 block

17	0	0	0	0	0	0	0
–1	–1	1	1	0	0	0	0
0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Table 6. Stego 8 × 8 block

164	155	145	148	158	164	161	155
159	155	151	151	156	160	160	159
154	158	158	157	154	154	158	163
152	157	165	161	153	150	157	165
152	160	167	164	156	151	156	164
156	160	164	165	159	156	156	158
162	160	159	178	164	163	157	152
166	160	155	159	167	167	158	147

3. Selective Scan is Applied
   For each $C_j \in I$
(a) when $T > 0$
ii Utilizing equation 3, extract the data bits.
iii Use equation 4 to restore the altered coefficients.
   Let the resultant block be E_j.

4. Inverse Selective Scan is Applied
5. Dequantize the elements of E_j as follows:

for $i_1 \leftarrow 1$ to 8 do
for $i_2 \leftarrow 1$ to 8 do

$$R_j\,(i_1, i_2) = E_j\,(i_1, i_2) \times Q(i_1, i_2);$$

end
end

Combine all the blocks R_j to get I i.e $I = \{R_1, R_2, \ldots R_l\}$.
6. For all embedded $R_j \in I$, repeat step 1 to step 5.

$$I_j = \begin{cases} 0 & \text{if } e\%2 = 0, \\ 1 & \text{otherwise.} \end{cases} \tag{3}$$

$$E_x = \begin{cases} \left(\left(c/0.44\right)^2\right) - 6 \text{ if } s = 0 \\ \left(\left(c/0.3\right)^2\right) - 6 \text{ if } s = 1 \end{cases} \tag{4}$$

Where $\overline{c}$ is the restored version of original c. Here |e| refer to round of e.

Note that the data extraction and embedding is the near-reversible.

It is communicated that embedding and extraction process is almost entirely reversible process. The extraction process requires the input to be a stego greyscale image that is 512 by 512 pixels. In order to obtain the original cover material, first apply de-quantization to the quantized coefficients, then apply inverse discrete cosine transform, and last merge all of the blocks that are 8 by 8.

Resultant blocks, the table is displayed in Table 8 following the application of de-quantization. Table 9 illustrates how

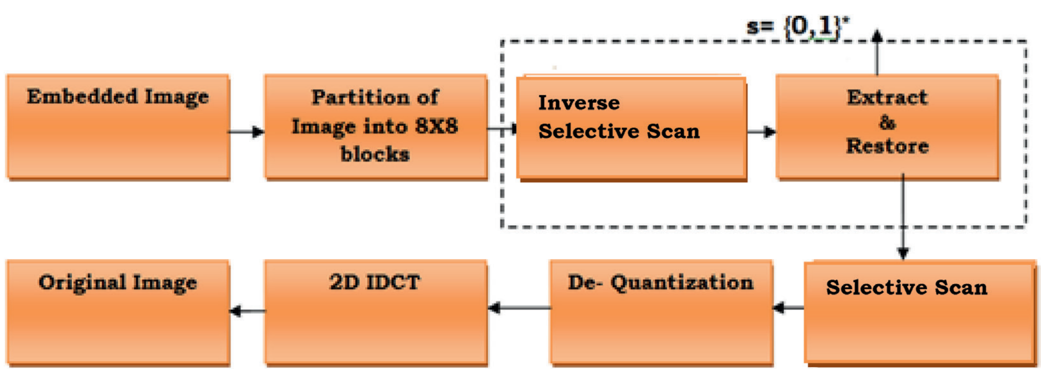

Figure 5. Extraction process

Table 7. stego 8 × 8 block

164	155	145	148	158	164	161	155
159	155	151	151	156	160	160	159
154	158	158	157	154	154	158	163
152	157	165	161	153	150	157	165
152	160	167	164	156	151	156	164
156	160	164	165	159	156	156	158
162	160	159	178	164	163	157	152
166	160	155	159	167	167	158	147

Table 8. de-quantization 8 × 8 block

486	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Table 9. IDCT 8 × 8 block

36.73	25.25	17.26	19.81	29.68	35.94	33.21	27.44
31.18	27.64	22.54	23.25	27.84	31.69	32.05	30.66
28.27	28.81	30.34	28.50	25.54	25.81	30.31	34.95
23.11	30.89	36.70	33.20	24.70	21.94	28.80	37.32
23.82	32.17	38.70	35.5	26.56	22.64	28.13	35.73
28.31	32.45	36.03	35.10	30.84	27.80	28.41	30.45
34.22	32.08	31.07	33.13	35.77	34.68	29.21	23.92
38.32	31.68	27.32	31.46	39.04	39.46	29.85	19.49

the input 8 × 8 block is subjected to inverse DCT. After the extraction procedure is finished, the resulting 8 × 8 block can be obtained by applying the inverse DCT and de-quantization to the embedded matrix, as indicated in Table 10. Figure 5 shows Extraction process.

4. RESULTS AND DISCUSSIONS

We have implemented our proposed method using MATLAB. We used GIF formatted grayscale images in the implementation.

Where function 1 is y = AC coefficients of original image,

Function 2 is $\sqrt{(5c^2 - 3c + 6)} * 0.44$

Function 3 is $\sqrt{(5c^2 - 3c + 6)} * 0.3$

Table 10. After extraction 8 × 8 block

159	155	140	146	148	159	164	159
157	157	148	155	162	164	159	157
159	150	157	159	157	157	157	162
157	159	159	164	157	157	159	157
155	159	162	159	155	159	159	157
162	159	157	155	159	162	155	155
164	162	159	162	159	159	159	155
159	157	162	159	159	157	157	157

Table 11. Embedded capacity of existing and proposed scheme

Image	Existing Scheme	Proposed Scheme
Aerial	56562	27562
Airplane	42608	39612
Baboon	74002	42549
Barb	39346	17615
Lena	30767	11416

Table 12. Existing and proposed scheme normal correlation

Image	Existing Scheme	Proposed Scheme
Aerial	0.998	0.995
Airplane	0.999	0.998
Baboon	0.997	0.996
Barb	0.998	0.997
Lena	0.996	0.995

Table 13. Existing & proposed scheme visual quality

Image	Existing Scheme	Proposed Scheme
Aerial	32.141	49.165
Airplane	40.797	58.801
Baboon	33.469	47.824
Barb	34.917	50.337
Lena	35.247	53.575

Where c the non-zero DCT coefficient and y be is the modified version of $\overline{c}$

Table 11. show that the existing and suggested schemes provide different results because we ignore low-frequency non-zero coefficients, which improves visual quality but reduces embedding capacity. Figure 6 shows Embedded barb image.

a) Existing watermark image b) Proposed watermark image

Figure 6. Embedded barb image

a) Existing image b) Proposed image

Figure 7. Embedded lena image

The Normalised Cross-Correlation examines the identification of images where [0, 1] the more the value near one the more highly correlated they are. Table 12. show that the suggested system achieves values closer to one than the present technique. The new design is extremely correlated and achieved about the same NK as existing scheme. Figure 7 shows Embedded lena image.

Table 13. both show that the proposed design achieves a higher PSNR than the existing scheme. This is something that can be seen by looking at the table and figure the proposed scheme performs better than the existing scheme since it disregards the low frequency of non zero components of the discrete cosine transform (DCT). We give a variety of images in the GIF format of varying sizes, and their resultant distorted images can be noticed from each observation. We can determine that the existing scheme distorts the images further than proposed scheme does, whereas the suggested method achieves superior visual quality.

CONCLUSION

The technique of data embedding appears to require improvement, which is why a new kind of data embedding, called near reversible data embedding was introduced. The nearly reversible method could be suitably applied to a very large variety of remote sensing applications. Implementation of log function transforms results in the transformation of coefficients where high difference is made, and hence degrades the visual quality with a number of images that are also vague. The superiority of the proposed system is realized in regards to high visual quality because the degree of the discrepancy made on the embedded and original non-zero DCT coefficients are minimized.

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