Journal of Theoretical and Applied Information Technology
30th April 2017. Vol.95. No 8

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

HOUGH TRANSFORM BASED WATERMARK EMBEDDING ALGORITHM IN DCT FREQUENCY DOMAIN

[1] MOHAMMED ALSULTAN, [2] THAER ALRAMLI , [3]AMMAR ALBAYATI, [4]ERSIN ELBASI
[1] Iraq Ministry of Electricity [2] Department of Computer Engineering, Mousl University,[3]Master in Computer Engineering, Cankaya University ,Turkey , [4]The Scientific and Technological Research Council of Turkey (TUBITAK)
E-mail: [1] mohammed.altaliby@gmail.com , [2]talramli@uomosul.edu.iq, [3]ammar.jameel.ict@gmail.com, [4]rersin.elbasi@tubitak.gov.tr.

ABSTRACT

In this paper, an algorithm has been proposed that makes use of Hough transform to locate the positions of lines in the cover image. The watermark was embedded in these positions in the original DCT domain. The robustness of the new algorithm has been evaluated and the experimental results were compared with the Chaotic Sequence Based Watermarking algorithm, which also work in the DCT domain. The Compression has been done depending on the Performance evaluation for imperceptibility and robustness of proposed algorithms. Several attacks were also used and peak signal to noise ratio (PSNR) value was calculated for cover image and watermarked image. Similarity ratio (SR) for the extracted watermark was also calculated. The Hough-based Watermark technique has been found robust against Gaussian, Histogram, Intensity, Gamma and Corp attacks. Whereas, the Chaotic-based Watermark technique was observed robust against Gaussian, Mean filter, Rotation, Histogram, Intensity, Gamma and Corp attacks.

Keywords: *Chaotic Sequence, Digital Watermarking, Discrete Cosine Transform (DCT), Hough Transform, Peak Signal to Noise Ratio (PSNR)*

1. INTRODUCTION

Many changes occurred in daily life habits such as making the capture, transmission, and storage of digital data, which are extremely easy and convenient because of internet. However, this raises a big concern of how to secure these data and prevent unauthorized use and this can be considered as a problem in many ways. The music and video industry loses billions of dollars per year due to illegal copying and downloading of copyrighted materials from the Internet but watermarking can efficiently stand as a solution and it is frequently used in such fields. The digital watermarking becomes very attractive research topic due to watermarking. The digital watermarking can be defined as a technology that creates and detects invisible markings, which can be used to trace the origin, authenticity, and legal usage of digital data. In order to make this happen, watermarking should be hard to notice, difficult to reproduce, and impossible to remove without destroying the medium that they meant to protect. The main development of digital watermarking in the future is simply like a copyright protection, pirate tracking, image authentication, cover-up communication [1] [2].

The watermarking algorithms can be simply divided initially into two groups: spatial domain method, which embeds the data by directly modifying the pixel values of the original image and transform domain method, which embed the data by modulating the transformation domain coefficients. A frequency-domain watermarking of certain frequencies is altered from their original & embeds the watermark into the transformed image. It is important to highlight that the frequency-domain is much more robust than the spatial domain technique. In frequency-domain technique multiple transforms are used for watermarking purposes such as DCT, DFT and DWT. And DFT (discrete Fourier transform) can be considered for watermarking, which is the most commonly used transform followed by DCT (discrete cosine transform) and DWT (discrete wavelet transform).

Now Frequency domain watermarking is considered as the more useful technique for all practical internet applications.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Watermark should have the characteristics listed below: Unobtrusiveness: it means that the watermark should be perceptually invisible, or its presence would not affect the work that is built to protect.

Robustness: it means that the watermark must be difficult or impossible to remove for effective work. If only partial knowledge is available (For example, the accurate location of the watermark in an image is unknown), then the attempts to remove or destroy a watermark should result in severe degradation in fidelity before the watermark is lost. In particular, the watermark should be robust in the following areas:

- *Common signal processing:* it means that the watermark should still be retrievable even if common signal processing operations are applied to the given data. This includes, digital-to-analog and analog-to-digital conversion, resembling, quantization (including dithering and recompression), and common signal enhancements to the images contrast and color, or audio bass and treble, for example:
- *Common geometric distortions (image and video data):* it means that Watermarks in images and videos data should be immune from geometric image operations such as rotation, translation, cropping and scaling.
- *Subterfuge attacks (collusion and forgery):* In addition, the watermark should be robust to collusion by multiple individuals who each possesses a watermarked copy of the data. So that, the watermark should be robust to combining copies of the same data set to destroy the watermarks.
- *Subterfuge attacks (collusion and forgery):* In addition, the watermark should be robust to collusion by multiple individuals who each possess a watermarked copy of the data. That is, the watermark should be robust to combining copies of the same data set to destroy the watermarks. Further, if a digital watermark is to be used in litigation, it must be impossible for colluders to combine their images to generate a different valid watermark with the intention of framing a third party.

Universality: it means that the same digital watermarking algorithm should apply to all three media under consideration. This is potentially helpful in the watermarking of multimedia Products. Also, this feature is conducive to implementation of audio and image/video watermarking algorithms on common hardware.

Unambiguousness: it means that Retrieval of the watermark should clearly identify the owner. Furthermore, the accuracy of the owners' identification should degrade gracefully in the face of attack. In this research tow algorithms were represented. In the first one, a chaos-based DCT domain data hiding algorithm was also used for still images. A chaotic map to generate a pseudo-random signal has also been used that behaves as embedding and detecting Key. The chaotic map is used for watermark signal spread in middle band of 8×8 block DCT coefficients of the cover image. The chaotic map can be used as pseudo-random generator [3], for digital data hiding, to increase security. This algorithm aimed to design a secure data hiding technique by using chaotic sequence. Then, the results were compared with the second algorithm that has been proposed, which makes use of Hough transform to locate the positions of lines in the cover image. And the watermark in these positions were embedded in the original DCT-domain. Binary logo image is used as watermark in both algorithms.

With rising commercial activities on internet and media industries, protection in the demand of images, audio and video are adhered against the processing and use. The redistribution and use of this information can be considered without undermining the rights of proprietor. In this regards, widespread demand in the effective techniques is observed to avoid the duplication of owner rights and copyright protection. Water marking is an efficient tool to identify ownership and discourage intellectual properties as it develop opportunities to recognize the owner, author and customer. On the contrary, diverse constraints are indicated such as robustness and imperceptibility in a watermarking method. JPEG compression is regarded to be the most causative aspect in the size reduction and attacking information exchange in the internet. The higher compression rate can merely influence the embedded watermark and proposed paradigm will ultimately weakened against the attack.

The main contribution of the present study was to explain the most Hough Transform variations elaborating the basic ones in detail. The study pursued the solutions in the literature for the drawbacks observed and underlined the direct applications. Whereas, the previous studies reviewed in the present investigation have supported the overall findings. The motivation to conduct the study was capacity analysis and optimization, which become an interesting fact that prompted to conduct the research.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

2. LITERATURE REVIEW

Several advantages of Hough transform is used to justify the implementation in DCT domain frequency. The Hough transformation is applicable in real-time applications for treating each image point independently. The effective voting scheme allows the algorithm to manage the partially deformed cases and noisy shapes. The specific cell appearance in the parameter space can be detected by using Hough transform. Furthermore, the implementation of Hough transform can be significant in detecting shapes beyond other lines. Numerous applications are embedded in Hough transform algorithm, which includes underwater tracking, road sign identification, lane detection and pipe and cable inspection. A high computational demand and a large storage is required in Hough transform and; therefore, it is the major drawback of this algorithm. The size of the accumulator array is reduced by considering the efficiency of the Hough transform [4].

The identification of lines is a core focus of the standard Hough transformation. Numerous variations have been indicated to recognize the irregular and analytical shapes. Researches have been conducted to identify the analytical or irregular shapes of the Hough transform [5-7]. These researches have comprehensively explained the use of Hough transform in detecting lines. Lines might be used to identify several different entities due to their abundance. The use of line detection is adhered from outdoor vehicle surveillance to indoor industrial applications. Prior studies have presented the rectangular and Gaussian windows in detecting high precision anticipation of Hough transform line parameters [8-10]. These two methods have been compared with Hough transform to indicate the accuracy of images. It has been indicated that rectangular and Gaussian windows are more effective to real and synthetic images as compared to standard Hough transform. A patchy Hough transform is also used to detect corners of feature points where intersections of straight lines are considered as corners. Dynamic combinatorial method and dual plane Hough transform method are combined to detect the line segments [11].

The approach has resulted into low storage requirement as well as an efficient implementation by considering the bounds of its parameter. Furthermore, line candidates have been detected efficiently by using a cascaded technique. The detection of a noisy image is indicated from the likelihood principle of connectivity and thickness. It has been observed that the probabilistic Hough transform is independent of the size, arrangement and shape of the accumulator array as compared with the conventional Hough transform approaches. The probabilistic Hough transform comprises of a larger immunity and lower bandwidth. The randomized Hough transform is instigated with the approaches of probabilistic and non-probabilistic features. In these approaches, n pixels are designated and included into the parameter space rather than transforming every single pixel into an n-1 hyper surface. Therefore, dynamic, window, random window and connective randomized Hough transform are included in the randomized Hough transform versions. Synthetic and real images are used to investigate the line detection [12].

The randomization and accumulation features are different in probabilistic Hough transform as compared to randomized Hough transform. The computation is reduced by implementing a progressive probabilistic Hough transform. The minimum fraction of votes are used to detect the lines in the progressive probabilistic Hough transform. Furthermore, it has been revealed that detection of pitch lines in the sporting videos are presented through grid Hough transform. The memory-efficient and fast grid Hough transform replaces the random point selection in the randomized Hough transform, using active grid. The random selection is not much efficient in forming the line-lets than the actively selected points. The expensive voting procedure can be avoided by using a statistical procedure [6].

Histograms and kernel estimates are used to measure the spatial coordinates in the statistical Hough transform. The parameters are estimated as well as the spatial coordinates are selected due to global nature of statistical Hough transform. It has been indicated that the presence of detected lines are avoided using a vanishing point algorithm. Furthermore, circles are transformed into lines by using a coordinate transform. The line parameters in polar coordinates are corresponded through the positions of the vanishing points. The k-means clustering are dependent on the vanishing point approach. Therefore, the intersection of lines extracted from the vanishing points is not required in this approach. The processing time and complexity in the statistical Hough transform are reduced through the vanishing points [7].

The point-to-point mappings are explicitly recognized as a line parameterizations, which map the vanishing points into image lines. The constructed mathematical tools in the point-to-point mapping triplets formulates the cascaded Hough transform. The vanishing points are utilized by detecting checkerboard structures. The lens distortion is compensated by enhancing the Hough transform line detection. Furthermore, Hough transform algorithm is used to detect 3D lines, using the range images of scenes. A laplacian operator accurately estimates the directions in the 3D, which detects the edge points of the line segments. According to the study, it has been identified that Hough transform algorithm is used for detecting analytical shapes including circles and ellipses. Gray scale images and binary images the dominant features on which the Hough transform and circular Hough transform depends upon. A preliminary edge detection technique including canny and sobel are used in both algorithms. In addition, these approaches are relied on the voting scheme for selecting set of coefficients [9].

Numerous studies have compared the instigation of circular Hough transform with the space saving approaches, the fast Hough transform and statistical Hough transform for circles [13-15]. The detection of 2D Hough transform and a radius histogram is identified by a two-step algorithm. In the first step, the centers of the circles are detected by using the Hough transform whereas the presence of radius histograms are validated in the second step. Furthermore, the genetic algorithm is used to detect the fine-tuning of the Hough transform parameter space [14].

The monitoring of distance and orientation of each point is included in the template vectors, which describe the shapes in these cases. These monitoring are observed from an arbitrary localization point to find compact local peaks. An appropriate localization point is reflected as a centroid of the template list. The image plane can reflect the position of translated instances of the shape. Each shape can be described or categorized by considering the position of its centroid. For instance, the identification of translated instances of a template shape could be illustrated through the coordinates of the centroid. Furthermore, shape parameters are recognized by locating peaks in a collector range as compared to other Hough transforms. It has been identified that this approach can be useful in finding rotated and scaled version of a shape, considering two parameters to represent their degrees of freedom [16].

Hough transform is effectively represented through voting procedure or evidence gathering. The developed image point is gathered or voted for all the parameter patterns used in the image region. A multidimensional accumulator range counts the vote to indicate the final number of the shapes reflected by parameters throughout the accumulator cell. The set of coefficients in the shape are voted consistently to generate peaks in the accumulator range. Thereby, it is apparent to observe that the Hough transform is able to manage numerous complexities existed in real world imagery. The presence of random extraneous data classifies the robustness of Hough transform due to distributed background of votes. It has been observed that distributed background of votes potentially hinders the indication of large compact disks. The Hough transform is concerned about missing data generated by poor occlusion or segmentation. These factors create a serious issue for parameter peaks by decreasing the height whereas it do not necessarily influence the detection approaches. The combination of each point is adhered from the image point, which reflects the inherent feature of Hough transform.

According to the study, it has been identified that large storage and computational requirements are the core drawbacks of the Hough transform [17]. The identification of this drawback is reflected from the use of large accumulator range. The representation of q dimensional space can be required for the determination of q parameters. The computational cost directly bears the size of the accumulator due to involvement of Hough transform algorithm for each image point.

3. CHAOTIC SEQUENCE

Chaos theory can describe certain dynamical system behavior which is an unpredictable, deterministic and uncorrelated system that exhibits noise-like behavior through its sensitive dependence on its initial conditions, which generates sequence similar to PN sequence [18]. A direct application of chaos theory to telecommunication system appears in conventional digital spread spectrum [19], where the information, is spread over a wide band using a chaotic sequence instead of the traditional periodic PN sequences.

Various non-linear dynamic systems are used to generate the chaotic sequence, e.g. logistic map and tent map [20], [21]. The most commonly used function to generate chaotic sequence is logistic map:

$$x_{k+1} = r.x_k(1-x_k) \qquad 0<x<1 \qquad (1)$$

$$x_{k+1} = (1-2x_k^2) \qquad -1<x<1 \qquad (2)$$

Where $0 < r \le 4$ is bifurcation parameter, research on chaos dynamic system show that when $3.569945 < r \le 4$, the logistic map is in chaotic state and sequence generated by logistic map is a non-periodic and sensitive to initial value [22]. In this paper, the parameter r and initial values x as key were used.

4. HOUGH TRANSFORM

The Hough transform (HT), due to Hough (1959), can be considered as the most frequently used algorithms in image analysis and computer vision [see, e.g., Ritter and Wilson (1996) and the survey articles by Leavers (1993) and Stewart (1999)].

The algorithm is frequently used detecting and estimating the parameters of multiple lines that are present in a noisy image (typically the image is first edge-detected and the resulting data serve as input to the algorithm) [23]. Line Detection and Line-Point Duality. Line detection is simply based on simple point/line duality. If a line in the image is defined by points whose coordinates satisfy the equation 3:

$$y = kx + c \qquad (3)$$

Then each point can also be seen as defined by the bundle of lines passing through it. A point P in x,y space defines, by equation 3 a line p in the k,c space; each (k,c) point l on the line p defines, in turn, a line L in the bundle of lines passing through P in the x,y space. For all the points P on a line L in x,y space, corresponding lines p form a bundle intersecting at a point l in k,c space. Coordinates of l are the parameters of line L, therefore this method can be thought of as a transform between spaces x,y and k,c (see Figure 1).

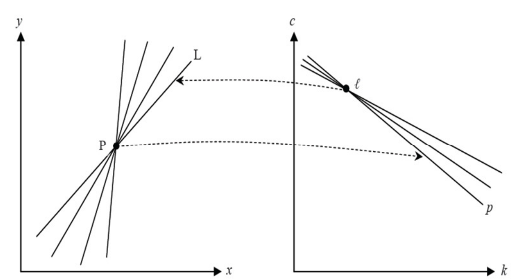

Fig 1: Line-point duality: point P (line bundle) in the image defines line p in the parameter space; point l (line bundle) in the parameter space defines line L in the image.

Now, let l be a line that is present in the image (x,y space), traced by some black pixels, possibly spread over the image in small fragments and mixed up with non-linear features. The line must nevertheless have a corresponding point l in the parameter (k,c) space. Let us also divide the parameter space into a raster of suitably fine cells. Each image pixel traces a line p in the parameter space, and the passage of that line through each cell is recorded. The cell corresponding to point l accumulates large numbers of hits, and thus identifies the line L in the original image. Non-linear features, on the other hand, contribute only to the background distribution of hits. Separation between the two is a matter of choosing some suitable threshold, and it is obvious that linear features with few pixels can be lost in a large volume of non-linear chaff [24].

4.1. Normal-form Parametrization of the Line:

Since the equation 4 has infinite slope for the vertical line, Duda and Hart [25] introduced a singularity-free alternative, the line parametrization:

$$p = x\cos\theta + y\sin\theta \qquad (4)$$

Here ρ is the line distance from the origin, and θ is the inclination of the normal. Like Equation 1, this formula defines a mapping between the image (x,y) space and the parameter (ρ,θ) space; however, image points define sine/cosine curves in the parameter space, rather than lines.

Using ρ and θ as the line parameters removes the slope singularity, but at the cost of computing trigonometric functions. Since these functions only need to be computed (tabulated) for one dimension of the parameter raster, the cost may well be acceptable.

A line in the x,y space is represented by the point of intersection of sine curves, in the characteristic "butterfly" pattern (see Figure 2), and the line detection consists of finding accumulation points of curves. Determining whether the point transform intersects a (presumably) rectangular cell of the raster is more complicated for curves than for straight lines, which can be observed through the discussion of the Fast Hough parameter search below [24].

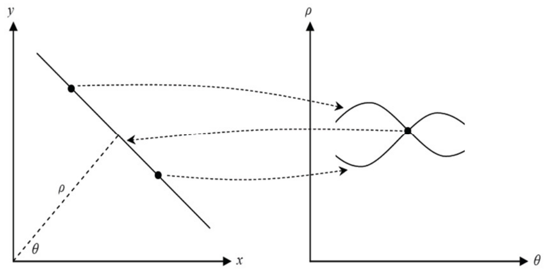

Fig 2: Normal-form parametrization and butterfly pattern.

5. DISCRETE COSINE TRANSFORM

With the character of discrete Fourier transform (DFT) Discrete cosine transform (DCT) turn over the image edge to make the image transformed into the form of even function. It is one of the most common linear transformations in digital signal process technology. Two dimensional discrete cosine transform (2D-DCT) is defined as:

$$F(jk) = a(j)a(k)\sum_{m=0}^{N-1}\sum_{n=0}^{N-1} f(mn)\cos\left[\frac{(2m+1)j\pi}{2N}\right]\cos\left[\frac{(2n+1)k\pi}{2N}\right] \quad (5)$$

The corresponding inverse transformation (Whether 2D-DCT) is defined as:

$$f(mn) = \sum_{m=0}^{N-1}\sum_{n=0}^{N-1} a(j)a(k)F(jk)\cos\left[\frac{(2m+1)j\pi}{2N}\right]\cos\left[\frac{(2n+1)k\pi}{2N}\right] \quad (6)$$

The 2D-DCT can not only concentrate on the main information of the original image into the smallest low frequency coefficient, but also it can cause the image blocking effect being the smallest, which can realize the good compromise between the information centralizing and the computing complication. So it obtains the wide spreading application in the compression coding.

6. PROPOSED METHOD

The implementation of Hough transform in both image and parameter space in the standard digital computer reflects the indexing numbers on the basis of minute and regular shaped regions. Real world measurements derive the image array, which is present in the form of binary numbers throughout the region of space. The parameter space is mapped through non-zero elements in order to accumulate the array of parameter hyper surfaces. It has been identified that discrete parameter space is reflected as an accumulator array, intersecting number of hyper surfaces to form a peak structure. The identification of spatially extended points is the major issue, which is comparatively resolved by implementing Hough transform. The Hough transform simply converts the task of finding compact local peaks into the accumulator array. The implication of Hough transform is implemented by considering the simple parametric shapes; however, detection of general shapes can be extended through Hough transform.

The Watermarking Techniques has been evaluated depending on the PSNR values. The PSNR can be defined as an engineering term for the ratio between the maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation.

$$MSE = \frac{1}{mn}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - In(i,j)]^2 \quad (7)$$

$$PSNR = 10.\log_{10}\left(\frac{Maxl^2}{MSE}\right) \quad (8)$$

Also, the similarity ratio (SR) was calculated between the extracted watermark and the original one, SR is defined as in equation (9):

$$SR = \frac{S}{S+D} \quad (9)$$

Where S and D represent the number of matching pixel values in compared images and the number of different pixel values in compared images, respectively. The SR was used in evaluation of non-blind watermark extraction. Moreover, the SR provided high precision for binary image watermarks. When different pixel values converge to 0, the SR will be close to 1, which is the optimum and desired condition.

7. EMBEDDING AND EXTRACTING

The general Formula for embedding and extraction, of watermark, that was used for both algorithms are as follow: Let I(i,j) be DCT Embedding Domain of Cover image, I'(i,j) the watermarked image, (a) is a factor which determines the strength of the watermark and W(i,j) the watermark image: Embedding Equation is:

$$I'(i,j) = I(i,j) + a * W(i,j) \quad (10)$$

Where: I(i,j) 8×8 blocks of the Cover image, I'(i,j) represent the Watermarked 8×8 blocks of the Cover image. Extraction Equation is:

$$W(i,j) = (I'(i,j) - I(i,j)) / a \quad (11)$$

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

7.1 Embedding

7.1.1. For chaos-based DCT domain algorithm

A digital data hiding technique was used to produce a secure algorithm using chaos. The chaotic map was used to generate two pseudo-random (PN) sequences, one for zero bit and other for one bit of watermark with low correlation. Generally pseudo-random noise sequence is generated by using the rand function in MATLAB. This periodic pseudorandom sequence generator must be initialized using a predefined "key". The proposed algorithm uses chaotic sequence which is highly sensitive to initial conditions. The algorithmic steps are discussed below:

1) Reading the watermark image.
2) Generating two PN sequences (to use it in the generation of chaotic sequence) by using logistic map under an initial value as secret key.
3) Then encrypting it by this sequence.
4) Reading the Cover image (I) and Transform it by using 8×8 block 2D-DCT.
5) Finally, embedding the W watermark binary image in the DCT block of the cover image using equation-10.

7.1.2. For Hough Transform-based DCT domain algorithm:

In this algorithm, the Hough transform has been used in order to locate the positions of lines segments in the cover image. After applying the Hough transform on the cover image, an accumulator matrix will be obtained, which contains the starting and the ending point of each line segment in the picture. Finally, depending on this matrix, the watermark was embedded in the positions of line segments in the original DCT-domain. The algorithmic steps are discussed below:

1) Reading the Cover image. Then, Applying Hough transform on it in order to get the line segments positions.
2) Reading the watermark image (W).
3) Reading the original Cover image (I) again and transform it into DCT-Domain.
4) Finally, embedding the W watermark binary image in the DCT block of the cover image (I) using equation-10.

7.2 Extracting:

7.2.2. For chaos-based DCT domain algorithm:

1) Read watermarked image (I').
2) Generate the same pseudo-random (PN) sequences (to use it in the decryption process of extracted watermark) that were used in embedding process by using logistic map.
3) Transform the watermarked image using 8×8 block 2D-DCT.
4) Extract the encrypted watermark image (W) using equation-11.
5) Decrypt the extracted watermark image to return it to its readable form by using the two (PN) sequences that was generated previously.

7.2.3. For Hough Transform-based DCT domain algorithm

1) Read watermarked image (I').
2) Transform watermarked (I') image into DCT-domain.
3) Finally depending on the positions of line segments that has been obtained from Hough transform, extract the W watermark binary image from the DCT block of the cover image (I') using equation-11.

$$CS_d = \sum_{i=0}^{1} \frac{F_d}{avg(F)} \times \frac{T_i}{T_d} \qquad (12)$$

8. RESULTS

In this paper and in both algorithms, the cover image (Goldhill 512x512) was used and watermark image (M) as shown in Figures (3, 4, 5 and 6). The used watermark size is 32*32 in Hough-based algorithm and 128*128 in Chaotic-based algorithm.

Figure 3: Goldhill image 512×512

Figure 4: Watermark image

Figure 5: Chaotic Sequence watermarked image

Figure 6: Hough Transform watermarked image

Attacks results: Following attacks were used for Gaussian Noise attack, Mean Filter attack, Scaling attack, Rotate attack, Histogram attack, Intensity attack, Gamma Correction attack, Crop attack, and Compression attack. Then, evaluation to the Watermarking Techniques were made depending on the PSNR values for the cover image after each attach. Also, the similarity ratio (SR) were calculated between the extracted watermark and the original one as in the following steps:

8.1 Gaussian Attack (mean=0, variance=0.001) (figures: 7, 8, 9 and 10).

Table 1. PSNR and SR for Gaussian Attack

Algorithm used	PSNR	SR
Hough – based	29.7364	0.9560
Chaotic – based	29.5256	0.8847

Figure 7: Hough-based watermarked image after Gaussian attack

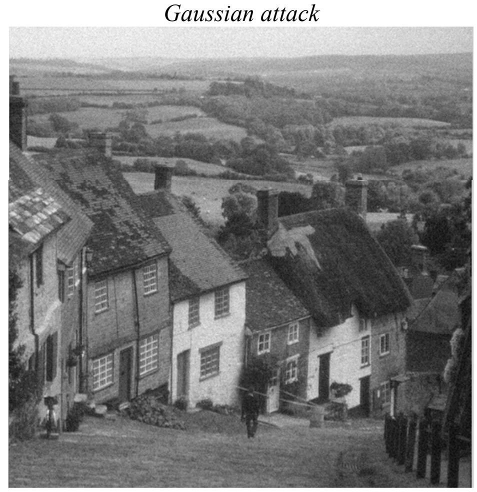

Figure 8: Chaotic-based watermarked image after Gaussian attack

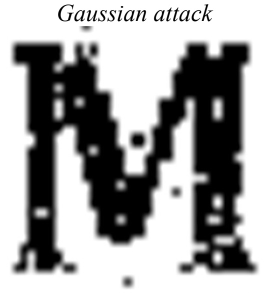

Figure 9: Hough-based, the extracted watermark image after Gaussian attack

Journal of Theoretical and Applied Information Technology
30th April 2017. Vol.95. No 8

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Figure 10: Chaotic-based, the extracted watermark image after Gaussian attack

8.2 Mean Filter Attack (Mask size=3×3) (figures: 11, 12, 13 and 14).

Table 2. PSNR and SR for Mean Filter Attack

Algorithm used	PSNR	SR
Hough – based	29.7760	0.4746
Chaotic – based	36.4896	0.1771

Figure 11: Hough-based watermarked image after Mean Filter attack

Figure 12: Chaotic-based watermarked image after Mean Filter attack

Figure 13: Hough-based, the extracted watermark image after Mean Filter attack

Figure 14: Chaotic-based, the extracted watermark image after Mean Filter attack

8.3 Scaling Attack minimize percentage 50%, (figures: 15, 16, 17 and 18).

Table 3. PSNR and SR for Scaling Attack

Algorithm used	PSNR	SR
Hough – based	29.6315	0.4248
Chaotic – based	36.7775	0.5191

Figure 15: Hough-based watermarked image after Scaling attack

Journal of Theoretical and Applied Information Technology
30th April 2017. Vol.95. No 8

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Figure 16: Chaotic-based watermarked image after Scaling attack

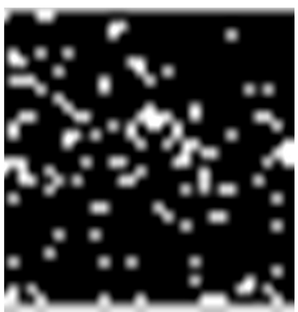

Figure 17: Hough-based, the extracted watermark image after Scaling attack

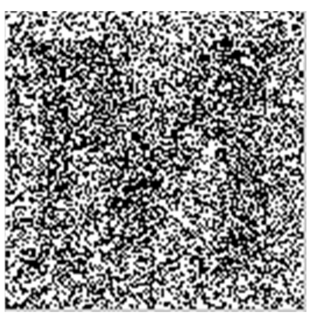

Figure 18: Chaotic-based, the extracted watermark image after Scaling attack

8.4 Rotate Attack 20˚, (figures: 19, 20, 21 and 22).

Table 4. PSNR and SR for Rotate Attack 20˚

Algorithm used	PSNR	SR
Hough – based	14.2283	0.6542
Chaotic – based	14.2478	0.9288

Figure 19: Hough-based watermarked image after rotate attack

Figure 20: Chaotic-based watermarked image after Rotate attack

Figure 21: Hough-based, the extracted watermark image after Rotate attack

Journal of Theoretical and Applied Information Technology
30th April 2017. Vol.95. No 8

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Figure 22: Chaotic-based, the extracted watermark image after Rotate attack

8.5 Histogram Attack equal (Automatic) (figures: 23, 24, 25 and 26).

Table 5. PSNR and SR for Histogram Attack

Algorithm used	PSNR	SR
Hough – based	17.5318	0.9492
Chaotic – based	17.4806	0.9992

Figure 23: Hough-based watermarked image after Histogram attack

Figure 24: Chaotic-based watermarked image after Histogram attack

Figure 25: Hough-based, the extracted watermark image after Histogram attack

Figure 26: Chaotic-based, the extracted watermark image after Histogram attack

8.6 Intensity Attack [l=0 h=0.8], [b=0 t=1] (figures: 27, 28, 29 and 30).

Table 6. PSNR and SR for Intensity Attack

Algorithm used	PSNR	SR
Hough – based	19.0896	0.9687
Chaotic – based	19.0846	0.9713

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Figure 27: Hough-based watermarked image after Intensity attack

Figure 28: Chaotic-based watermarked image after Intensity attack

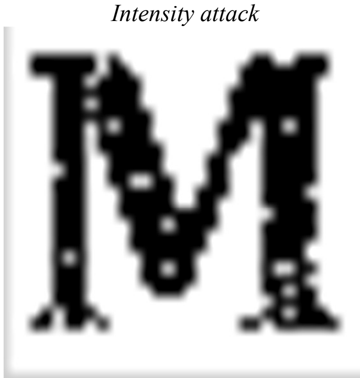

Figure 29: Hough-based, the extracted watermark image after Intensity attack

Figure 30: Chaotic-based, the extracted watermark image after Intensity attack

8.7 Gamma Correction Attack (1.5) (figures: 31, 32, 33 and 34).

Table 7. PSNR and SR for Gamma Correction Attack

Algorithm used	PSNR	SR
Hough – based	17.6834	0.9687
Chaotic – based	17.6783	0.9988

Figure 31: Hough-based watermarked image after Gamma Correction attack

Figure 32: Chaotic-based watermarked image after Gamma Correction attack

Figure 33: Hough-based, the extracted watermark image after Gamma Correction attack

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Figure 34: Chaotic-based, the extracted watermark image after Gamma Correction attack

8.8 Crop Attack (Both Side) (figures: 35, 36, 37 and 38).

Table 8. PSNR and SR for Crop Attack

Algorithm used	PSNR	SR
Hough – based	13.0431	0.9394
Chaotic – based	13.0584	0.8703

Figure 35: Hough-based watermarked image after Crop attack

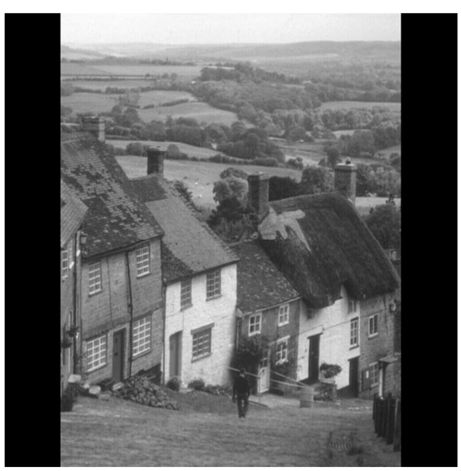

Figure 36: Chaotic-based watermarked image after Crop attack

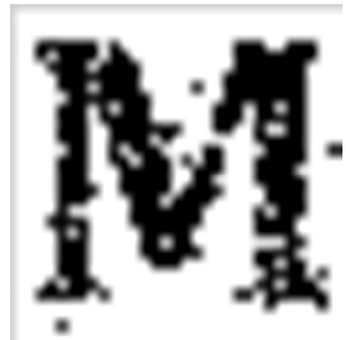

Figure 37: Hough-based, the extracted watermark image after Crop attack

Figure 38: Chaotic-based, the extracted watermark image after Crop attack

8.9 JPEG Compression Attack (Q=25) (figures: 39, 40, 41 and 42).

Table 9. PSNR and SR for JPEG Compression Attack

Algorithm used	PSNR	SR
Hough – based	31.4210	0.4873
Chaotic – based	36.9153	0.5072

Figure 39: Hough-based watermarked image after JPEG Compression attack

Figure 40: Chaotic-based watermarked image after JPEG Compression attack

Figure 41: Hough-based, the extracted watermark image after JPEG Compression attack

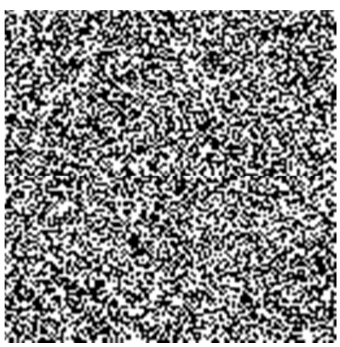

Figure 42: Chaotic-based, the extracted watermark image after JPEG Compression attack

9. DISCUSSION

The performance of watermark based detection system has no reactive measure due to the distribution of original version of video on sharing sites. The vanishing process of watermarking ascends due to video compression. Numerous methods have been indicated to apply embedded watermark into an original image. Fourier, cosine and wavelet transforms are the dominant schemes on which these watermark algorithms are observed. On the other hand, the performance of transform based algorithm are usually specified in the watermark embedding and predefined set of coefficients. Thereby, it has been observed that an individual can easily replace the embedded watermark when image and embedding watermark are scrutinized on the basis of predefined set of coefficients. The selection of particular set of coefficients is important for the placement in watermark algorithm [7,8].

The embedded high frequency coefficients in the watermark will be vanished if low pass filtering attack are implemented in the DCT frequency domain. On the other hand, it will reduce the quality of an image in case of low frequency coefficients, which are selected. It is a fact that DCT frequency domain operates a very high energy compaction, which enables human vision to detect frequency alterations. Human vision is surrounded with the shape of objects provided through a large amount of interpretation of images. The existing methods have been effective in reshaping the major issues in computer vision. The handling of complex scenes along with numerous objects should be allowed by effective shape recognition system. The recognition algorithm should enable to manage the complexities experienced by poor attributes of image sensors and the restricted capability of existing segmentation algorithms in detecting computer vision systems [9].

The main objective of the study was to present the two algorithms that hide the DCT-domain watermark. Depending on several applied attacks on watermarked image have been employed to make a comparison between them. The power of attacks have been measured depending upon the PSNR and SR values. In the present study, an algorithm has been proposed that makes use of Hough transform to locate the positions of lines in the cover image. The Hough transform is the most dominant algorithm, which has the capability to eradicate these complex issues. The description of Hough transform algorithm is based on the parameter extraction technique, which illustrates the components of the model. The relative position and orientation are captured by the model to distinguish the occurrences of the shape in its detection. Therefore, the Hough transform recognizes particular parameter values to find the image points of the shape. The identified parameter value is indicated through the predictions of the model. Each image point is reflected in the Hough transform for turning and mapping the multidimensional parameter. The intersection of several points are categorized through the parameter point of the shape. Thereby, the Hough transform is identified as a method of detecting these specific points of intersection.

10. CONCLUSIONS

Numerous studies have indicated that the Hough transform is the best solution for manipulating the transformed DCT domain. The disposition of robustness is observed from the compression or the multi-resolution domain. The domains of watermark embedding are automatically revealed against the robust compression. Further, the possibility of watermark embedding detection is increased by using the robust compression features. Watermarking and content based detection are categorized as dominant detection techniques for the video copy approaches. These techniques are classified in accordance to their merits and disadvantages. The appropriate features of watermark entails effective metadata as well as sustains low computational cost for operation of copy detection. On the contrary, watermark is not specifically used in the detection of transformations such as crop, blur, rotate, camcording and resize. These transformations are performed in creating video copy. Present study was limited to the watermarking based on Hough transform only. Whereas, a fast fashion algorithm based on the water marking approach has been recommended for the future research.

In this paper, two algorithms have been presented that hide the watermark in DCT-domain, and make a comparison between them depending on several applied attacks on watermarked image. The power of attacks has been measured Depending on PSNR and SR values, thus from these values, it has been concluded that:

- For Hough-based Watermark technique, the watermark is robust against (Gaussian, Histogram, Intensity, Gamma and Corp) attacks.
- For Chaotic-based Watermark technique, the watermark is robust against (Gaussian, Mean filter, Rotation, Histogram, Intensity, Gamma and Corp) attacks.
- In Hough-based Watermark technique, Depending on SR value in Gaussian and Corp attacks the quality of the extracted watermark is better than Chaotic-based Watermark technique.
- In Chaotic-based Watermark technique, Depending on SR value in Histogram, Intensity and Gamma attacks the quality of the extracted watermark is better than Hough-based Watermark technique.

REFERENCES

[1] M. Chandra, S. pandey, and R. Chudhary, “Digital watermarking technique for protecting digital images,” in Computer Science and Information Technology (ICCSIT), 2010 3rd IEEE International Conference on, vol. 7. IEEE 2010, pp. 226-233.
[2] M. Jiansheng, L. Sukang, and T. Xiaomei, “A digital watermarking algorithm based on dct and dwt,” in International Symposium on Web Information System and Applications. Citeseer, 2009, pp. 104-107.
[3] W. Xiao, Z. Ji, J. Zhang, and W. Wu, “A watermarking algorithm based on chaotic encryption,” in TENCON’02. Proceedings. 2002 IEEE Region 10 Conference on Computers, Communications, Control and Power Engineering, vol. 1. IEEE, 2002, pp. 545-548.
[4] P. Mukhopadhyay, BB, Chaudhuri, “A survey of Hough Transform”, *Pattern Recognition*, Vol. 48 No. 3, 2015 Mar 31, pp. 993-1010.
[5] M. Camurri, R. Vezzani, R. Cucchiara, “3D Hough transform for sphere recognition on point clouds”, *Machine vision and applications*, Vol. 25 No. 7, 2014 Oct 1, pp. 1877-1891.
[6] N. Pozzobon, F. Montecassiano, P. Zotto, “A novel approach to Hough Transform for implementation in fast triggers”, *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, Vol. 834, 2016 Oct 21, 81-97.
[7] AS. Hassanein, S. Mohammad, M. Sameer, ME. Ragab, “A survey on Hough transform, theory, techniques and applications”, arXiv preprint arXiv:1502.02160. 2015 Feb 7.
[8] OJ. Woodford, MT. Pham, A. Maki, F. Perbet, B. Stenger, “Demisting the Hough transform for 3D shape recognition and registration”, *International Journal of Computer Vision,* Vol 106 No. 3, 2014 Feb 1, pp. 332-41.
[9] VN. Luong, NT. Trinh, VC. Ho, “A Watermark Algorithm against De-Synchronization Attacks”, *VNU Journal of Computer Science and Communication Engineering*, Vol 32 No. 2, 2016, pp. 49-62.
[10] LV. Nguyen, “A Watermark Algorithm against De-Synchronization Attacks”, *VNU Journal of Science: Computer Science and Communication Engineering*, Vol. 32 No. 2, 2016 May 31.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

[11] XQ. Yang, "A digital watermarking algorithm based on wavelet transform", In *Applied Mechanics and Materials* 2014 (Vol. 687, pp. 3992-3995). Trans Tech Publications.

[12] NK. Sarva, UN. Rao, "Robust & Blind Video Watermarking Algorithm Using SVD Transform", In *International Journal of Engineering Research and Technology* 2014 May 28 (Vol. 3, No. 5 (May-2014)). IJERT.

[13] XY. Wang, YN. Liu, S. Li, HY. Yang, PP. Niu, "Robust image watermarking approach using polar harmonic transforms based geometric correction", *Neurocomputing*, Vol. 174, 2016 Jan 22, pp. 627-642.

[14] Z. Xu, BS. Shin, R. Klette, "Accurate and robust line segment extraction using minimum entropy with Hough transform", *IEEE Transactions on Image Processing*, Vol. 24 No. 3, 2015 Mar, pp. 813-822.

[15] Z. Xu, BS. Shin, R. Klette, "Closed form line-segment extraction using the Hough transform", *Pattern Recognition*, Vol. 48 No. 12, 2015 Dec 31, pp. 4012-4023.

[16] Z. Xu, BS. Shin, R. Klette, "A statistical method for line segment detection", *Computer Vision and Image Understanding*, Vol. 138, 2015 Sep 30, pp. 61-73.

[17] PS. Ramesh, S. Letitia, "A novel approach for converting 2D into 3D images using Hough feature extraction technique", *Advances in Natural and Applied Sciences*, Vol. 9(6 SE), 2015 Jun 1, pp. 426-35.

[18] A. Kanso and N.Smaoui, "Logistic chaotic maps for binary numbers generations," chaos, solitons and fractals, vol. 40. No. 5, pp. 2557-2568, 2009.

[19] P. Stavroulakis, Chaos applications in telecommunications. CRC press, 2005.

[20] W. Hai and H. Jiandong, "Logistic-map chaotic spread spectrum sequence [j]," ACTA Electronica sinica, vol. 1, 004, 1997.

[21] M. Jessa, "The period of sequences generated by tent-like maps," Circuits and System I: Fundamental Theory and Applications, IEEE Transactions on, vol. 49, no. 1, pp. 84-89, 2002.

[22] M. Youssef, M. Zahara, A. Emam, and M. A. Elghany, "Image encryption using pseudo random number and chaotic sequence generators," in Radio Science Conference, 2009, pp. 1-15.

[23] A. Goldenshluger and A. Zeevi, "The Hough transform estimator," Annals of Statictics, pp. 1908-1932, 2004.

[24] D. Antolovic, "Review of the hough variant for line detection, implementation of the fast hough variant for line detection," Department of Computer Science, Indiana University, 2008.

[25] R. O. Duda and P. E. Hart, "Use of hough transformation to detect lines and curves in pictuers," Communications of the ACM, vol. 15, no. 1, 11-15, 1972.