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Watermarking Image Depending on Mojette Transform for Hiding Information

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Abstract – This paper describes a new image watermarking method for which is suitable for both copyright protection and information hiding. The presented method is based upon the morphological mathematics properties of the Mojette Transform [1,2] and the Mojette Phantoms[3]. The main properties of the Mojette transform are briefly introduced and the concept of linked phantoms which depicts the null space of the operator is presented. In this paper the Mojette Phantoms can be used not only as the embedded watermark, but also can be used as the mark which is inscribed with some certain information, e.g. Chinese characters. Corresponding embedding and extractions of either the mark or the hidden message are then described. Finally, experimental results are presented in the last section.

Keywords: Mojette, Watermarking, Transform, Hiding, Image.

I. INTRODUCTION

Inscribing invisible marks into an image has a variety of applications such as copyright, steganography or data integrity checking. There are many techniques can be used for watermarking, such as DCT, DWT and so on. In [3], the authors presented a method which use the Mojette Phantoms as the mark and hide the mark in the Mojette domain. However, the mark used in [3] is meaningless. In this paper we present a new method that can hide watermark which bear certain meanings. In particular, we implement the proposed method so that Chinese characters contain designed meanings can be hidden in the input image.

II. THE MOJETTE TRANSFORM

A. Direct Mojette Transform (MT)

The Mojette Transform is a kind of discrete Radon transforms [4]. This transform needs many angles such as

$$\theta = arc\tan\left(\frac{q}{p}\right)$$

where (p,q) are integers restricted to PCD(p,q) = 1. For an image at each angle, we can acquire a group of projections. Every projection is called a bin. The process of the transform can be described by the following M*p,q* operator :

$$M_{p,q}f(k,l) = \sum_{k=-\infty}^{+\infty}\sum_{k=-\infty}^{+\infty} f(k,l)\Delta(b+kq-lp) \text{ where}$$

$$\Delta(b) = \begin{cases}1, if b = 0\\ 0, if b \neq 0\end{cases}, \qquad (1)$$

and $M_I f(k,l)$ is denoted as the set of I projections:

$$M_I f = \{M_{pi,qi} f; i \in \{1,2,\ldots I\}\}$$

In another way, given an image and an angle, its projections are acquired by adding together the gray value of the pixels along the straight lines of m+qk-lp=x. Figure 1 shows an example.

B. Inverse Mojette transform

The inverse Mojette transform is the process of inverse the projections into the origin gray values of pixels. There have many ways to implement the inverse Mojette transform and we usually use the simplest one: first, select a projection which contains only one pixel; second, select the projections which contain this pixel and subtract the gray value of this pixel from these projections. Then do the above steps repeatedly until all the pixels are retrieved. This is shown in Figure 2.

C. Mojette phantoms

The Mojette phantoms is an image which has the projections for all the given angles are zeros. The virtue of the Mojette phantoms is when adding the Mojette phantoms into an image the image's projections for the given angles will not change. Figure 3 show the properties of the Mojette phantoms.

D. Watermark processing

The Mojette phantoms can be embedded into the original image as the watermark. However, the original Mojette phantoms can not carry any meaningful information. In contrast we present a new method which allows the watermark composed by the Mojette phantoms to be able to hide meaningful information. The idea is to let the Mojette phantoms have a small size, and the watermark comprises multiple blocks of the Mojette phantoms.

The specific process is as follow:
Step 1: Design the information to be carried in the watermark.
Step 2: According to the information of the watermark, we construct a watermark by the phantoms (Figure 3) and a block whose pixel gray values are all zeros. We merge the blocks of the phantoms and the zero blocks as every block is a pixel. If there is the information we fill the watermark by the phantoms blocks. Otherwise it is filled by the zero blocks. Figure 4 shows how to design the watermark. An example is showed in figure 5. We can see meaningful information is hidden in the watermark. In this way we can hide meaningful watermark in the original image and achieve information security. For example, the information hidden in the image can be the name of the owner or the number which has a special meaning.

E. Embedding scheme

For a given image and the information of the watermark, we should design the block size of the Mojette phantoms and the angles which are used to take projections. The number of the angles is denoted by *I*. We embed the watermark in the following steps:

Step 1: For the origin image, we segment it into small blocks and denote the size of the block by $n\times n$. The purpose of this procedure is to facilitate the calculation of the Mojette transform.
Step 2: For each block, we take the Mojette transform at the given *I* angles. At every angle, all the projections can be regarded as a set of projections. So we acquire *I* projections.
Step 3: According to the first (*I*-1) angles, we can create the correlative Mojette phantoms whose size is $n\times n$. We can obtain the watermark by splicing the small blocks of the Mojette phantoms and the zero blocks.
Step 4: Embedding the watermark [5] in every block of the origin image. Then we can get the watermarked image.
Step 5: Segment the marked image into small blocks same as the origin image.
Step 6: For every blocks of the marked image, we take the Mojette transform at the given *Ith* angles. The (*I*+1)th projection is acquired. Figure 6 shows the process of embed watermark.
Once the embedding scheme is finished, we can transmit the projections.

F. Decoding algorithm

When the receiver receives the (*I*+1) projections, the origin image and the marked image can be retrieved according to the projections and the given angles. The first *I* projections are used to obtain the origin image, and the marked image is generated by the first *(I-1)* projections and the last projection. The specific process can be described by the following steps:

Step 1: For the first *I* projections, take the inverse Mojette transform to obtain the original image based on the size of the block.
Step 2: For the first (*I*-1) projections and the last projection, take their inverse Mojette transforms to generate the marked image.
Step 3: Subtract the original image from the marked image to retrieve the watermark. Figure7 shows the process of extract watermark. By comparing the extracted watermark and the original watermark, we can find whether the projections have been changed.

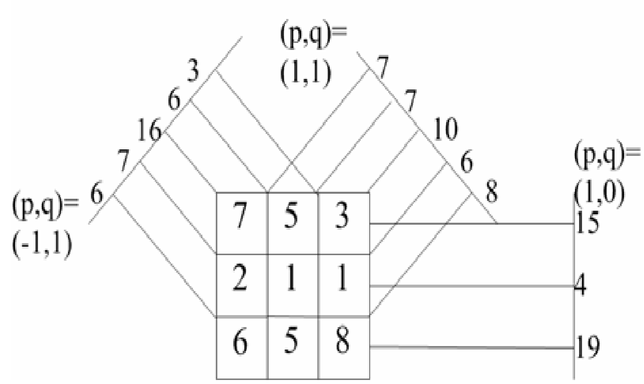

Figure 1. The direct Mojette transform for a 3 × 3 support and 3 projections.

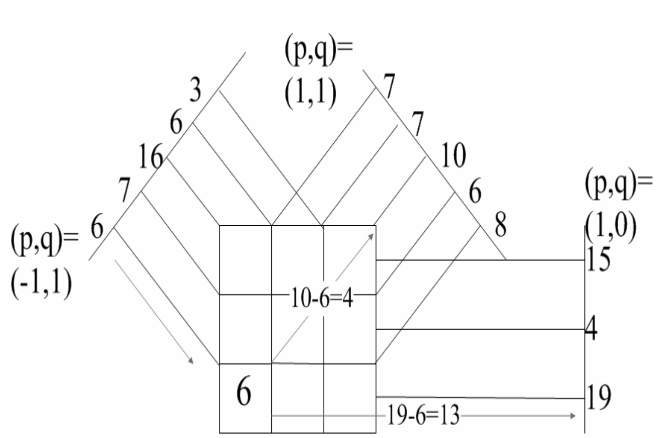

Figure 2. The process of the inverse Mojette transforms.

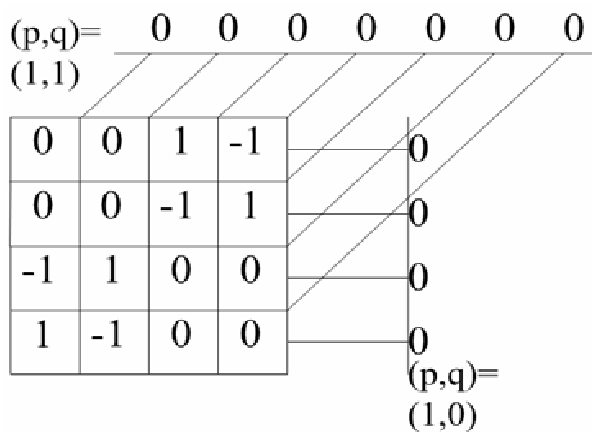

Figure 3. the Mojette phantoms

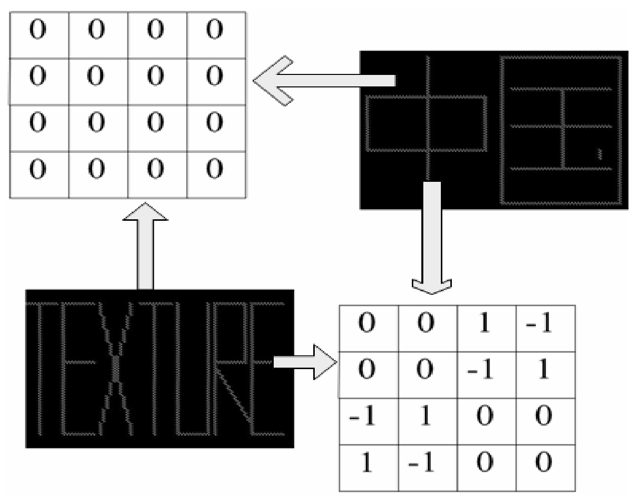

Figure 4. How to design the watermark. The areas we want are filled by the phantoms blocks otherwise they are filled by zero.

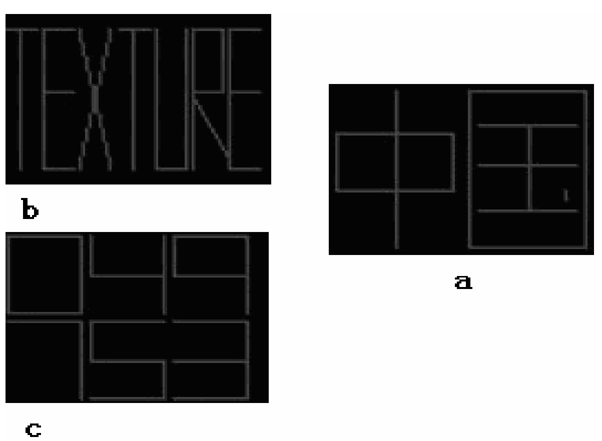

Figure 5. A set of watermarks composed of the Mojette phantoms with meaningful information.(a).a watermark containing two Chinese characters meaning China (b) a watermark which is an English word ‘texture’ (c) a watermark which is the code of a traffic police office

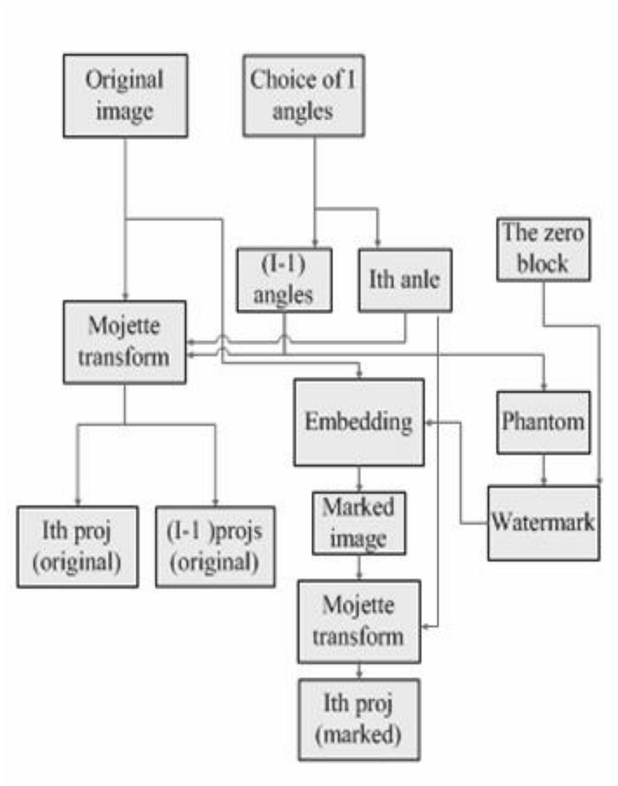

Figure 6. Embedding watermark process

III. EXPERIMENTAL RESULTS

We use a set of car images and watermarks in Figure 5 as the input, and thus we can get the marked images. The watermark is composed of a number of blocks as depicted in Figure 3. The angles used to take projections are (-2,1),(1,1),(1,0) and those used to gain the phantoms are (1,1),(1,0). Figures 8,9,10 show a set of experiment results.

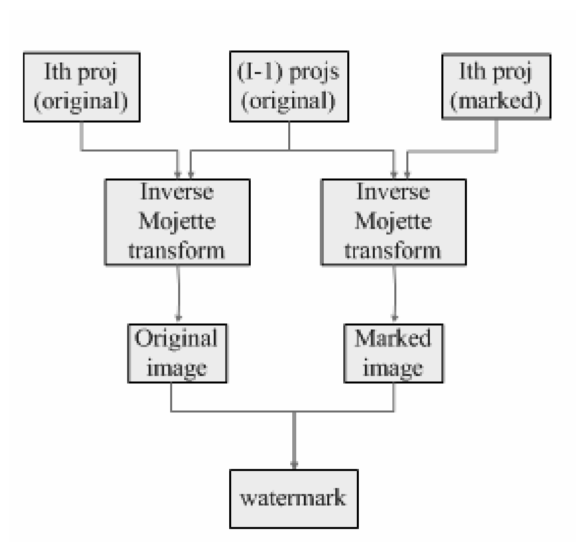

Figure 7. How we extract watermark

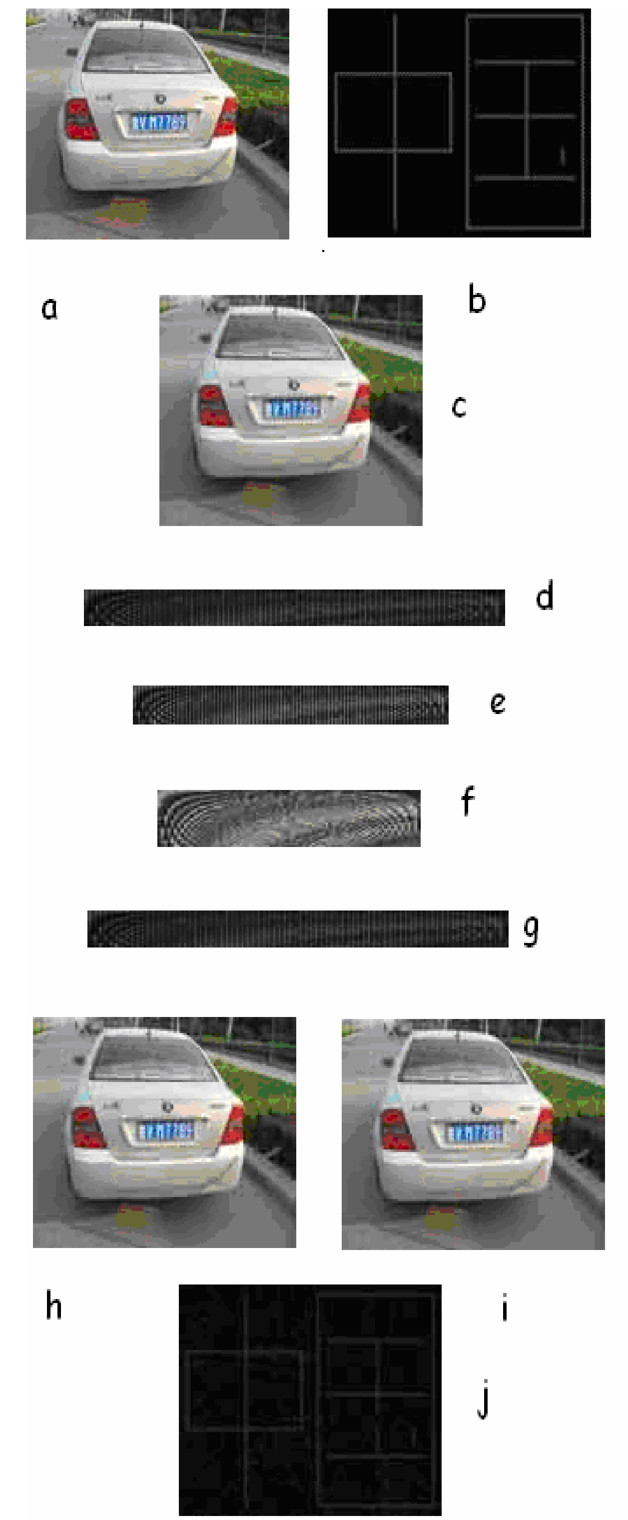

Figure 8. (a) the original image.(b) the watermark.(c) the marked image (d) the projections of the original image at angle (-2,1).(e) the projections of the original image at angle (1,1).(f) the projections of the original image at angle (1,0).(g) the projections of the marked image at angle (2,1). (h) The retrieved origin image.(i) the retrieved marked image. (j) The extracted watermark.

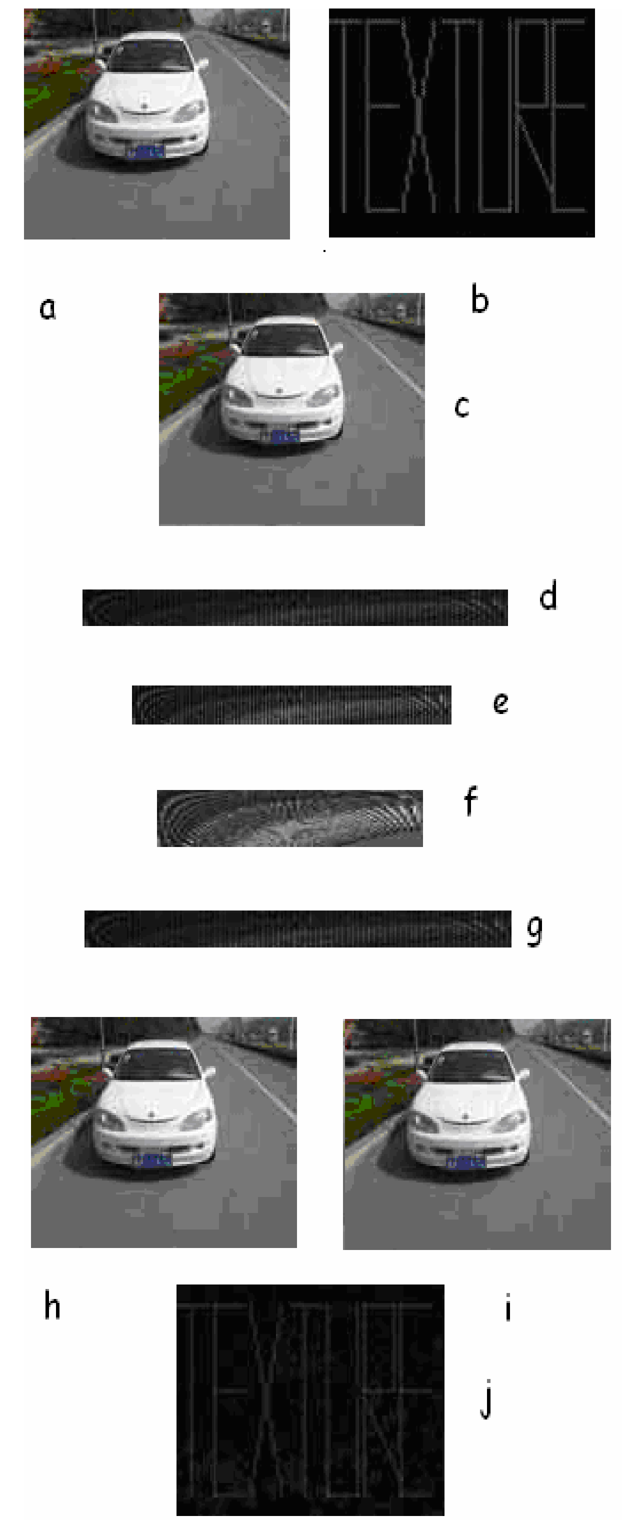

Figure 9. (a) the original image.(b) the watermark.(c) the marked image (d) the projections of the original image at angle (-2,1).(e) the projections of the original image at angle (1,1).(f) the projections of the original image at angle (1,0).(g) the projections of the marked image at angle (-2,1). (h) The retrieved origin image.(i) the retrieved marked image. (j) The extracted watermark

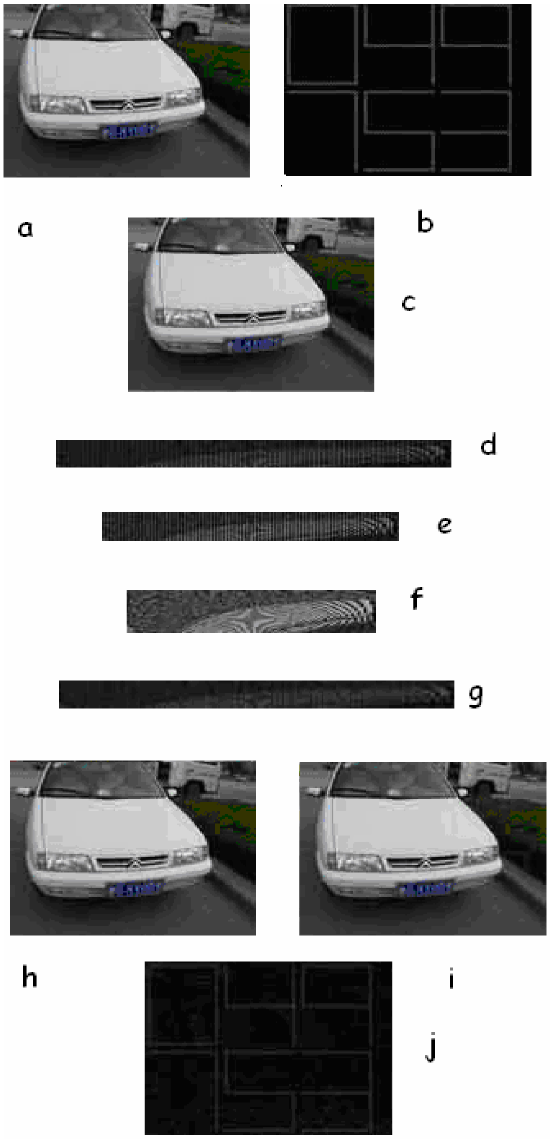

Figure 10. (a) the original image.(b) the watermark.(c) the marked image (d) the projections of the original image at angle (-2,1).(e) the projections of the original image at angle (1,1).(f) the projections of the original image at angle (1,0).(g) the projections of the marked image at angle (-2,1). (h) The retrieved origin image.(i) the retrieved marked image. (j) The extracted watermark

IV. CONCLUSION

A new watermarking method based on the mojette transform that can hide special information in the original image is presented in this paper. Experimental results show it is effective once the meaningful watermark is successfully constructed. However, it should be noted that this method might have problems if complex information is required to be hidden as efficient construction of this kind of watermark can be difficult watermark.

REFERENCES

[1] N. Normand, JP. Guédon, "La transformée Mojette: une représentation redondante pour l'image", Comptes rendus Académie des sciences de Paris, theoretical computer science section, p. 124-127. January **1998**.

[2] F. Autrusseau, J. V. Guedon, and Y. Bizais. Mojette cryptomarking scheme for medical images. Volume **5032**, pages 958–965. SPIE, **2003**.

[3] F Autrusseau, JV Guedon Image Watermarking for Copyright Protection and Data Hiding via the Mojette Transform Proceedings of SPIE, **2002**

[4] J. RADON. Ober die Bestimmung von Funktio-nen durch ihre Integralwerte l¨angs gewisser Mannigfaltigkeiten. Computed Tomography, 27, **1983**.

[5] F. Autrusseau, A. Saadane, D. Barba " Psychovisual Approach for Watermarking", SPIE Electronic Imaging: Security and watermarking of multimedia contents, January **2001**, San Jose, CA.

[6] M. Kutter and F. A. P. Petitcolas, "A fair benchmark for image watermarking systems" , Proc. SPIE Electronic Imaging Security and watermarking of multimedia contents, San Jose, CA, Vol. **3657**, p. 226-239, January **1999**.

[7] JP. Guédon, B. Parrein, N. Normand, "Internet distributed image databases", Integrated Computer Aided Engineering, Vol.**8**, p. 205-214, **2001**.

[8] M. Katz, "Questions of uniqueness and resolution in reconstruction from projections", Springer Verlag, **1977**.

[9] Hewa Majeed Zangana, "Watermarking System Using LSB", *IOSR Journal of Computer Engineering (IOSR-JCE)*, Vol. **19**, Issue **3**, Ver. II, P. 75-79, (May.-June. **2017**).

[10] Harshal V. Patil1, B. H. Barhate2, "A Review Paper on Data Hiding Techniques: Stegnography", *International Journal of Scientific Research in Computer Science and Engineering*, Vol.**06**, Issue.**01**, pp.64-67, **2018**

[11] Manisha Verma, Hardeep Singh Saini, "Analysis of Various Techniques for Audio Steganography in Data Security", *International Journal of Scientific Research in Network Security and Communication*, Vol.**7**, Issue.**2**, pp.1-5, **2019**

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