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A Steganography Approach to hiding two images using DNA microarray

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Abstract: The steganography is defined as to hide information from unauthorized user. Degree of success of a staganography procedure depends on two factors –First, amount of information hiding,second,rate of distortion of cover image.In this paper propose a unique method of steganography which hidings two secret images with in a cover image. Uniqueness of this method is that hide two secret images without distortion of cover image.DNA microarray and it's hybridization procedure use as a tool for implementation.

Keywords*:* Cover-image, Secret-image, DNA microarray, cDNA, Probes, Hybridization, Hybridized image

I. INTRODUCTION

In steganography, we study techniques to achieve secret communication between two parties that are interested in hiding not only the content of a secret message but also the act of communicating it. To this aim, steganography algorithms ("stego algorithms") embed the secret information into different types of "natural" cover data like sound, images, or video. The resulting altered data is referred to as stego-data and it must be perceptually indistinguishable from its natural cover. On the other hand, stego-analysis seeks to analyze (possibly altered) cover data to decide whether a message has been embedded in it or not. Thus, the problem can be seen as one of classification into two classes, namely, natural and stego-data.[1].

Microarray is a high-throughput technology available for genetic researchers to analyze expression of thousands of gens simultaneously [2,3,8]. DNA microarray consists of a grid of tiny spots of capture molecules with each spot usually corresponds to a different gene. These arrays are usually formed by printing the capture molecules onto a glass slide by either robotic spotting or in-situ synthesis [2, 5, 9]. First step in using the DNA microarray array is to extract ribonucleic acid (RNA) from the cells; RNA indicates which genes are currently active. The RNA is processed to form fluorescently labeled cDNAs known as probes that will hybridize to their corresponding targets in the microarray. Typically, control and test RNA samples are processed on the same array using two different dye tagged probes (e.g. ,the red fluorescent dye Cy5 and green fluorescent dye Cy3)[2,9,11]. The final step of the laboratory process is to produce an image of the surface of the hybridized array. The microarray is then scanned by activation with laser at appropriate wavelength to excite each dye [5].The relative fluorescence between each dye on each spot is then recorded and a composite image may produce [3].By comparing gene expression in normal and disease cells, microarrays can be used to identify disease genes for the development of therapeutic drugs [4].The main
goal of array image processing is to measure the intensity of the spots and quantify the gene expression values based on these intensities. This process consists of three steps: array localization or gridding, segmentation, and quantification [5, 8]. The accuracy of these steps is critical, since this process will directly impact the strategy and quality of the microarray data [6]. Gridding is to assign each spot with individual compartments. This is
An "ideal" cDNA microarray image is obtained in terms of its image content. The image content would be characterized by deterministic grid geometry, known background intensity with zero uncertainty, pre-defined spot shape (morphology), and constant spot intensity that (a) is different from the background, (b) is directly proportional to the biological phenomenon (up- or –down regulation), and (c) has zero uncertainty for all spots.

Figure-1 shows an example of such an ideal microarray image. While finding such an ideal cDNA image is probably a pure utopia, it is a good starting point for understanding image variations and possibly simulating them [10].

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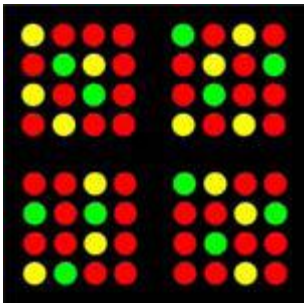

Figure-1 Illustration of an "ideal" microarray image

A typical DNA microarray experiment provides the expression profiles of several tens of samples (say Ns% 100), over several thousand (Ng) genes. These results are summarized in an Ng×Ns expression table or gene expression matrix; each row corresponds to one particular gene and each column to a sample. Entry Egs of such an expression table stands for the expression level of gene g in sample s. The original gene expression matrix obtained from a scanning process contains noise, missing values, and systematic variations arising from the experimental procedure. Data pre-processing is indispensable before any analysis can be performed.[11]

In this propose method two secret images embedding. Embedding is done by DNA microarray hybridization procedure. In this steganography procedure not dependents on size of secret-images, as well as size of cover-image size can be smaller than secret-images. Even secret-images is independent to each other. This is totally a unique procedure where sending two images, which will confuse unauthorized user to detect cover-Image. These two images are Cover-image and Hybridized image. Here Hybridized image acts as steganography key. Figure 2 show 4x16 DNA micro array.

	AA	**AC**	**AG**	**AT**	**TA**	**GA**	**CA**	**CC**	**CG**	**TC**	**TG**	**TT**	**CT**	**GT**	**GC**	**GG**
A	**AAA**	**AAC**	**AAG**	**AAT**	**ATA**	**AGA**	**ACA**	**ACC**	**ACG**	**ATC**	**ATG**	**ATT**	**ACT**	**AGT**	**AGC**	**AGG**
C	**CAA**	**CAC**	**CAG**	**CAT**	**CTA**	**CGA**	**CCA**	**CCC**	**CCG**	**CTC**	**CTG**	**CTT**	**CCT**	**CGT**	**CGC**	**CGG**
G	**GAA**	**GAC**	**GAG**	**GAT**	**GTA**	**GGA**	**GCA**	**GCC**	**GCG**	**GTC**	**GTG**	**GTT**	**GCT**	**GGT**	**GGC**	**GGG**
T	**TAA**	**TAC**	**TAG**	**TAT**	**TTA**	**TGA**	**TCA**	**TCC**	**TCG**	**TTC**	**TTG**	**TTT**	**TCT**	**TGT**	**TGC**	**TGG**

Figure-2 4×16 DNA micro array

II. DESIGN DETAILS

The remainder of the paper is organized as follows. In Section 2 Design details. In Section 3, Algorithm of encoding and decoding is presented. In Section 4, presents the experimental results. In Section 5, conclusion is given. The encoding flowchart is shown below:

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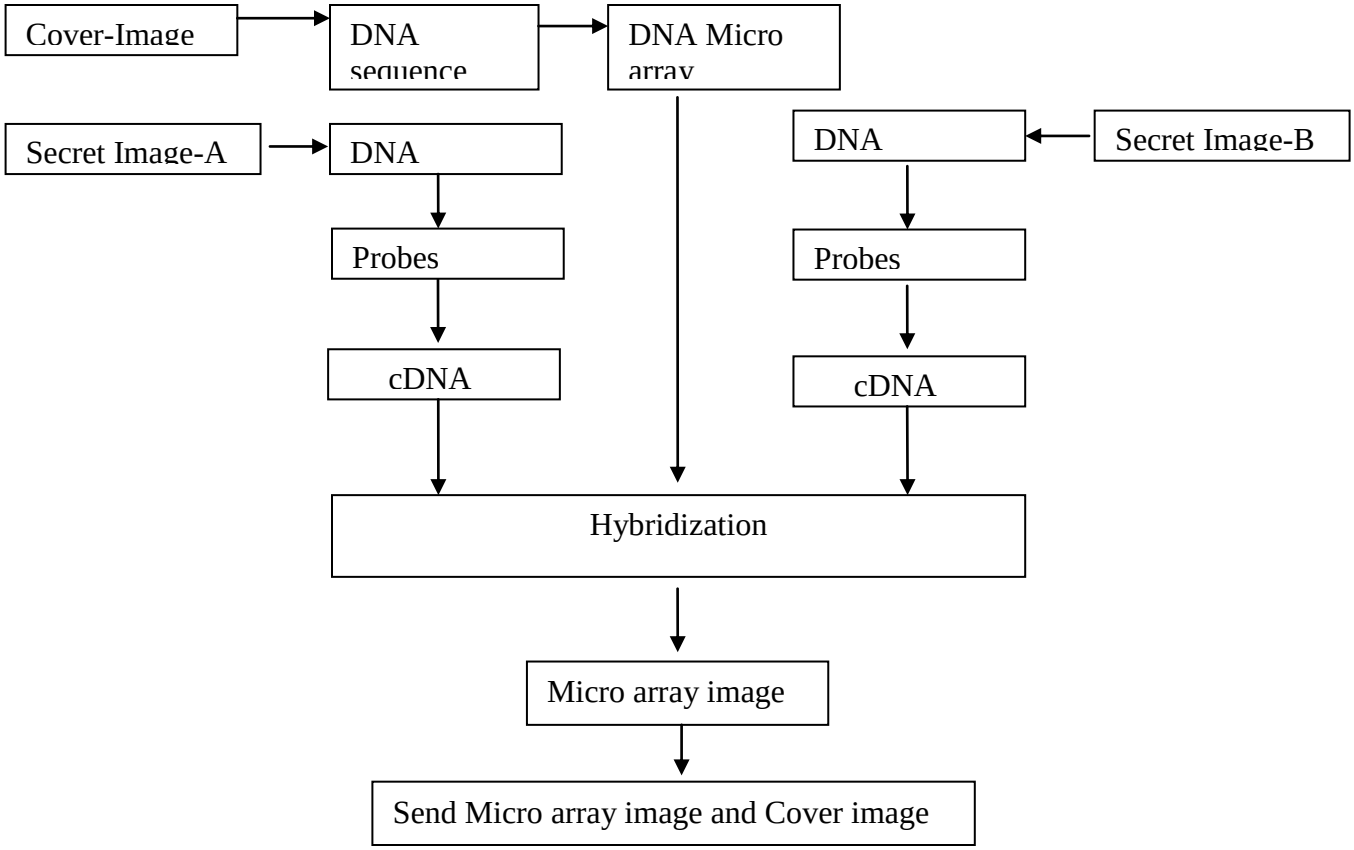

2. Decoding Flowchart

The decoding system is described in figure 3.

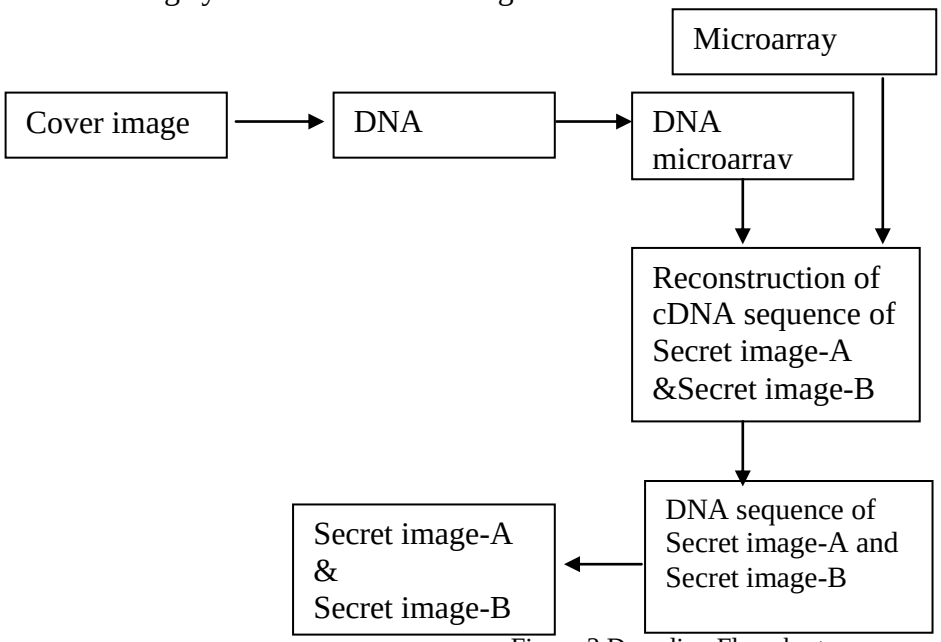

Figure 3 Decoding Flowchart

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III. HYBRIDIZATION ALGORITHM

1. Take DNA microarray of Cover-Image.
2. Take DNA sequence of Secret-image-A and Secret-image-B.
3. Make these DNA sequences into probs.
4. Convert these DNA sequences into complemented DNA sequence (cDNA).
5. Resulting cDNA sequences labeled with fluorescent dye. Commonly use dyes are Cy3 for green and Cy5 for red.
6. Compare green labeled cDNA sequence with each microarray index position.
7. If a index position contains complement form of cDNA probe then makes green spot for that index position .How many spot will make depends upon sequence no. of that probe in cDNA sequence.
   Otherwise do nothing.
8. Repeat Step-5 to Step-6 for red labeled cDNA sequence.
9. End.

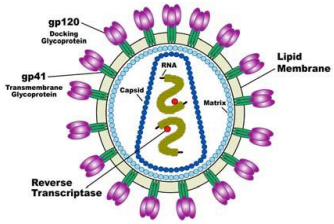
IV. ALGORITHM FOR RECONSTRUCTION OF SECRET IMAGE-A AND SECRET IMAGE-B FROM HYBRIDIZED IMAGE

Step-1: Take the DNA microarray of Cover-image.
Step-2: For Secret image-A, scan hybridized image to identify which position of microarray contain single green spot. This index position contain is the 1st probe of cDNA sequence of Secret image-A.
Step-3: Similarly scan for 2nd,3rd & 4th so on.
Step-4: Complement all probes to get actual probes.
Step-5: Assembled these probes to construct the DNA sequence.
Step-6: From this DNA sequence get the Secret image-A.
Step-7: Repeat Step-2 to Step-6 for Secret image-B(Red spot).
Step-8: End.

V. EXPERIMENTAL RESULT

Cover-Image

Secret Image-A



Secret Image-B

DNA microarray for the above Cover-Image is in Figure-4, which is chosen arbitral.

DNA sequence of Secret Image-A and Secret Image-B respectively is "CTTCCGTGCGATGTAGCCGGTATCTTTGGA CATTGGTATATTTCA " and "ATTAGGTACACGGGATGGCCTAGT TAC CGCAAT".Segmenting this DNA sequences in three nucleotides Probes -"CTT CCG TGC GAT GTA GCC GGT ATC TTT GGA CAT TGG TAT ATT TCA " and "ATT AGG TAC ACG GGA TGG CCT AGT TAC CGC AAT" respectively .Corresponding cDNA form are "GAA GGC ACG CTA CAT CGGCCA TAG AAA CCT GTA ACC ATA TAA AGT " and "TAA TCC ATG TGC CCT ACC GGA TCA GCG TTA" respectively.

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Following microarray image in Figure-4 generates after hybridization of cDNA sequence of Secret image-A and Secret image-B in microarray of Cover-image

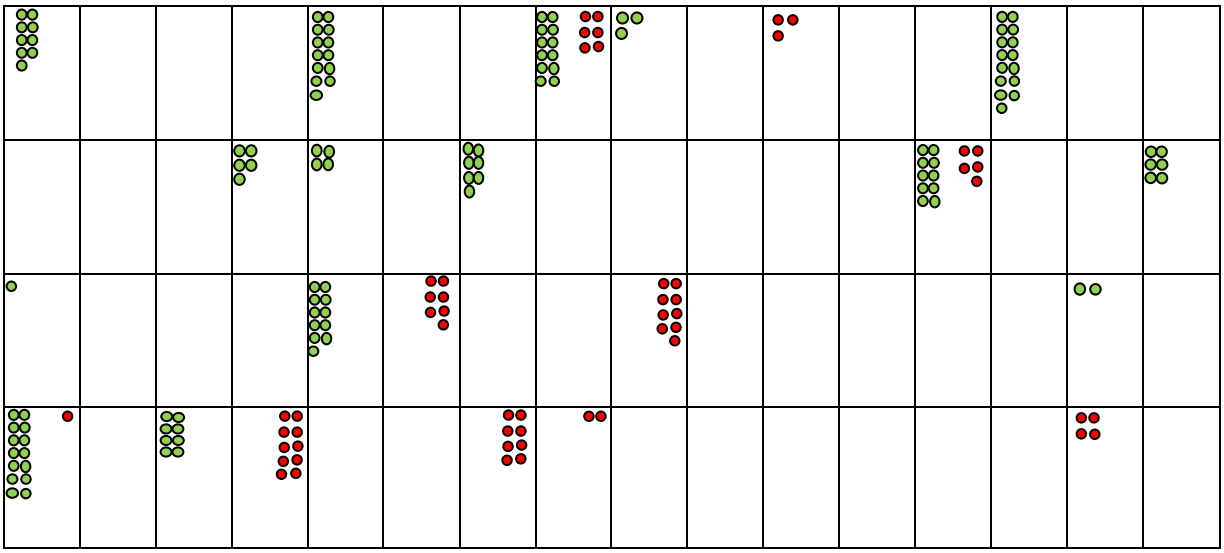

Figure-4: Micro array Image

VI. CONCLUSION

DNA microarray consists of a grid of tiny spots of capture molecules with each spot usually corresponding to a different gene. This paper proposes a unique method of steganography which hidings two secret images with in a cover image. Result obtained is encouraging.

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