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Effective Secret Communication in Preventing Cyber Crimes Using Affine Transformation A Review

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Abstract: The world has become advanced in internet and communication technology. The trillions of data are created, copied and transmitted via internet or mobile phones, tabs, laptop at every fraction of second. Hence, cryptography, steganography, watermarking techniques are in great demand in digital era for secure communication. Scrambling methods transform meaningful information into disorder and unsystematic patterns. In case if attacker extracts the hidden message, the meaningful order of patterns remains undetected and our data is secured from the unauthentic user. In this the methodology adopted for effective secret communication is reviewed and discussed in detail.

Keywords: **Affine transformation, image scrambling, cyber crimes**

I. INTRODUCTION

In recent years with the growth of internet and the digital technology, it broadens the scope of right and wrong, as there are privacy violations, information theft and so on [1]. Digital images are widely used now a day so its security is very vital. Now digital security is a major theme in computer security. As the number of users increases exponentially, the need to protect data and the multimedia on the Internet has become a high priority. Most of the encryption algorithms are based on textual data. These algorithms may not be suitable for encrypting image data types.[1]

Computer crime, or **cybercrime**, is any crime that involves a computer and a network. The computer may have been used in the commission of a crime, or it may be the target. Dr. DebaratiHalder and Dr. K. Jaishankar (2011) define Cybercrimes as:"Offences that are committed against individuals or groups of individuals with a criminal motive to intentionally harm the reputation of the victim or cause physical or mental harm, or loss, to the victim directly or indirectly, using modern telecommunication networks such as Internet [2]

In geometry, an affine transformation, affine map or an affinity is a function between affine spaces which preserves points, straight lines and planes. Also, sets of parallel lines remain parallel after an affine transformation. An affine transformation does not necessarily preserve angles between lines or distances between points, though it does preserve ratios of distances between points lying on a straight line. Examples of affine transformations include translation, scaling, homothetic, similarity transformation, reflection, rotation, shear mapping, and compositions of them in any combination and sequence. If X and Y are affine spaces, then every affine transformation $f : X \to Y$ is of the form $x \mapsto Mx + b$, where M is a linear transformation on X and b is a vector in Y. Unlike a purely linear transformation, an affine map need not preserve the zero point in a linear space. Thus, every linear transformation is affine, but not every affine transformation is linear.

For many purposes an affine space can be thought of as Euclidean space, though the concept of affine space is far more general (i.e., all Euclidean spaces are affine, but there are affine spaces that are non-Euclidean). In affine coordinates, which include Cartesian coordinates in Euclidean spaces, each output coordinate of an affine map is a linear function (in the sense of calculus) of all input coordinates. Another way to deal with affine transformations systematically is to select a point as the origin; then, any affine transformation is equivalent to a linear transformation (of position vectors) followed by a translation.

In the traditional method of transform proposed by Arnold [3] the transform is given by:
where

x ,y = original image co-ordinate

x', y' = transform image co-ordinate

demerits of this transform is that the all four transform parameters or coefficients are fixed in nature so if somehow any one can identify that conventional Arnold transform is used to scramble the image, by using fixed value of those coefficient , he can easily descramble the image.

A block location scrambling algorithm of digital image based on Arnold transform [4] performs similar operation to Arnold transform except its matrix coefficients are different from traditional Arnold transform. The transform algorithm for above proposed algorithm is given below:

QI DAONG-XU has proved that for a matrix when elements satisfying the criteria that ad-bc = 1 [9]. Its transformation coefficients can be used as scrambling

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transformation. Demerits of this algorithm is that out of four matrix coefficients only two coefficient are unknown limiting choice to choose different matrix coefficients i.e. or simply 2. Secondly its first matrix coefficients i.e. are still fixed to one or unity

Improved Arnold Transform or IAT : [3]

An Improved Arnold Transform or IAT was proposed in 2010 by MA DING & FAN JING [3]. Transform equation for IAT is given as:

When transform matrix choose different coefficients, K is having maximum value from transform matrix coefficient, which ensures that transformed parameters are not to be negative, resulting in an unique inverse matrix, when this matrix is non singular in nature that means the determinant of that matrix is non-zero which is a region based selective image encryption technique which provides the facilities of selective encryption and selective reconstruction of images.

II. PROPOSED METHODOLOGY

Affine Transformation

In many imaging systems, detected images are subject to geometric distortion introduced by perspective irregularities wherein the position of the camera(s) with respect to the scene alters the apparent dimensions of the scene geometry. Applying an affine transformation to a uniformly distorted image can correct for a range of perspective distortions by transforming the measurements from the ideal coordinates to those actually used. (For example, this is useful in satellite imaging where geometrically correct ground maps are desired.)

An affine transformation is an important class of linear 2-D geometric transformations which maps variables (*e.g.* pixel intensity values located at position (x_1, y_1) in an input image) into new variables (*e.g.* (x_2, y_2) in an output image) by applying a linear combination of translation, rotation, scaling and/or shearing (*i.e.* non-uniform scaling in some directions) operations.

In order to introduce the utility of the affine transformation, consider the image Where in a machine part is shown lying in a fronto-parallel plane. The circular hole of the part is imaged as a circle, and the parallelism and perpendicularity of lines in the real world are preserved in the image plane. We might construct a model of this part using these primitives; however, such a description would be of little use in identifying the part .

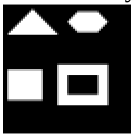
Here the circle is imaged as an ellipse, and orthogonal world lines are not imaged as orthogonal lines.

This problem of perspective can be overcome if we construct a shape description which is *invariant* to perspective projection. Many interesting tasks within model based computer vision can be accomplished without recourse to Euclidean shape descriptions (*i.e.* those requiring absolute distances, angles and areas) and, instead, employ descriptions involving *relative* measurements (*i.e.* those which depend only upon the configuration's intrinsic geometric relations). These relative measurements can be determined directly from images. Figure 1 shows a hierarchy of planar transformations which are important to computer vision.

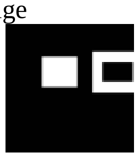
Most implementations of the affine operator allow the user to define a transformation by specifying to where 3 (or less) coordinate pairs from the input image (x_1, y_1) re-map in the output image (x_2, y_2). (It is often the case, as with the implementation used here, that the user is restricted to re-mapping *corner coordinates* of the input image to *arbitrary new coordinates* in the output image.) Once the transformation has been defined in this way, the re-mapping proceeds by calculating, for each output pixel location (x_2, y_2), the corresponding input coordinates (x_1, y_1). If that input point is outside of the image, then the output pixel is set to the background value. Otherwise, the value of (i) the input pixel itself, (ii) the neighbour nearest to the desired pixel position, or (iii) a bilinear interpolation of the neighbouring four pixels is used.

We will illustrate the operation of the affine transformation by applying a series of special-case transformations (*e.g.* pure translation, Pure rotation and pure scaling) and then some more general transformations involving combinations of these.

Starting with the 256×256 binary artificial image



we can apply a translation using the affine operator in order to obtain the image



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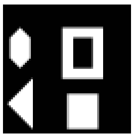
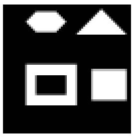
In order to perform this pure translation, we define a transformation by re-mapping a single point (*e.g.* the input image lower-left corner $(0,0)$) to a new position at $(64,64)$.

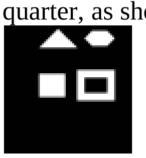
A pure rotation requires re-mapping the position of two corners to new positions. If we specify that the lower-left corner moves to $(256,0)$ and the lower-right corner moves to $(256,256)$, we obtain



Similarly, reflection can be achieved by swapping the coordinates of two opposite corners, as shown in



Scaling can also be applied by re-mapping just two corners. For example, we can send the lower-left corner to $(64,64)$, while pinning the upper-right corner down at $(256,256)$, and thereby uniformly shrink the size of the image subject by a quarter, as shown in



Note that here we have also translated the image. Re-mapping any 2 points can introduce a combination of translation, rotation and scaling. A general affine transformation is specified by re-mapping 3 points. If we re-map the input image so as to move the lower-left corner up to $(64,64)$ along the 45 degree oblique axis, move the upper-right corner down by the same amount along this axis, and pin the lower-right corner in place, we obtain an image which shows some shearing effects

Notice how parallel lines remain parallel, but perpendicular corners are distorted.

Affine transformations are most commonly applied in the case where we have a detected image which has undergone some type of distortion. The geometrically correct version of the input image can be obtained from the affine transformation by re-sampling the input image such that the information (or intensity) at each point (x_1,y_1) is mapped to the correct position (x_2,y_2) in a corresponding output image.

One of the more interesting applications of this technique is in remote sensing. However, because most images are transformed before they are made available to the image processing community, we will demonstrate the affine transformation with the terrestrial image

which is a contrast-stretched (cutoff fraction = 0.9) version of

We might want to transform this image so as to map the door frame back into a rectangle. We can do this by defining a transformation based on a re-mapping of the (i) upper-right corner to a position 30% lower along the *y*-axis, (ii) the lower-right corner to a position 10% lower along the *x*-axis, and (iii) pinning down the upper-left corner. The result is shown in

Notice that we have defined a transformation which works well for objects at the depth of the door frame, but nearby objects have been distorted because the affine plane transformation cannot account for distortions at widely varying depths. It is common for imagery to contain a number of perspective distortions. For example, the original image shows both affine and projective type distortions due to the proximity of the camera with respect to the subject. After affine transformation, we obtain

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Notice that the front face of the captain's house now has truly perpendicular angles where the vertical and horizontal members meet. However, the far background features have been distorted in the process and, furthermore, it was not possible to correct for the perspective distortion which makes the bow appear much larger than the hull,

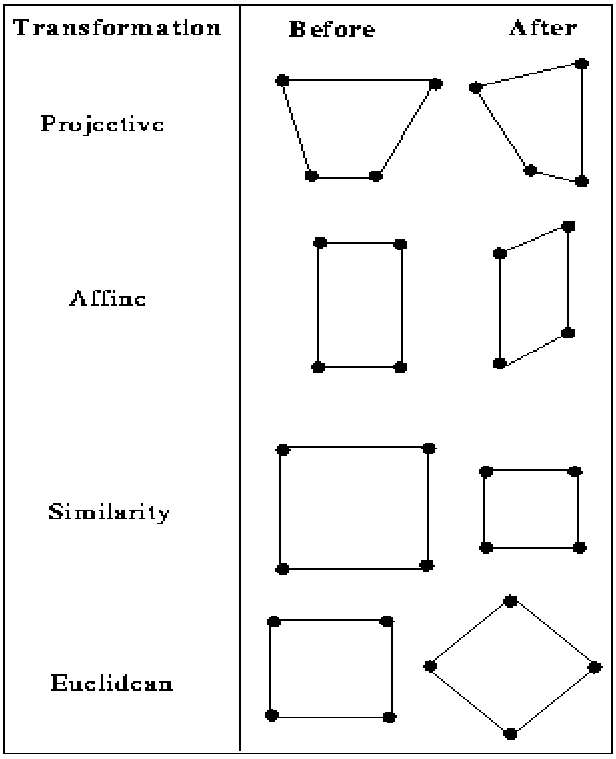

Fig 1 **Hierarchy of plane to plane transformation from Euclidean (where only rotations and translations are allowed) to Projective (where a square can be transformed into any more general quadrilateral where no 3 points are collinear). Note that transformations lower in the table inherit the invariants of those above, but because they possess their own groups of definitive axioms as well, the converse is not true.**

The transformation of the part face shown in the example image above is approximated by a planar *affine* transformation. (Compare this with the image

Where the distance to the part is not large compared with its depth and, therefore, parallel object lines begin to converge. Because the scaling varies with depth in this way, a description to the level of *projective* transformation is required.) An affine transformation is equivalent to the composed effects of translation, rotation, isotropic scaling and shear. The general affine transformation is commonly written in homogeneous coordinates as shown below:

$$\begin{vmatrix} x_2 \\ y_2 \end{vmatrix} = A \times \begin{vmatrix} x_1 \\ y_1 \end{vmatrix} + B$$

By defining only the *B* matrix, this transformation can carry out pure translation:

$$A = \begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix}, B = \begin{vmatrix} b_1 \\ b_2 \end{vmatrix}$$

Pure rotation uses the *A* matrix and is defined as (for positive angles being clockwise rotations):

$$A = \begin{vmatrix} cos(\theta) & -sin(\theta) \\ sin(\theta) & cos(\theta) \end{vmatrix}, B = \begin{vmatrix} 0 \\ 0 \end{vmatrix}$$

Here, we are working in image coordinates, so the y axis goes downward. Rotation formula can be defined for when the y axis goes upward.

Similarly, pure scaling is:

$$A = \begin{vmatrix} a_{11} & 0 \\ 0 & a_{22} \end{vmatrix}, B = \begin{vmatrix} 0 \\ 0 \end{vmatrix}$$

(Note that several different affine transformations are often combined to produce a resultant transformation. The order in which the transformations occur is significant since a translation followed by a rotation is not necessarily equivalent to the converse.)

Since the general affine transformation is defined by 6 constants, it is possible to define this transformation by specifying the new output image locations (x_2, y_2) of any three input image coordinate (x_1, y_1) pairs. (In practice, many more points are measured and a least

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squares method is used to find the best fitting transform.) [5]

III. IMAGE SCRAMBLING TECHNIQUE

Fig.2. Original image

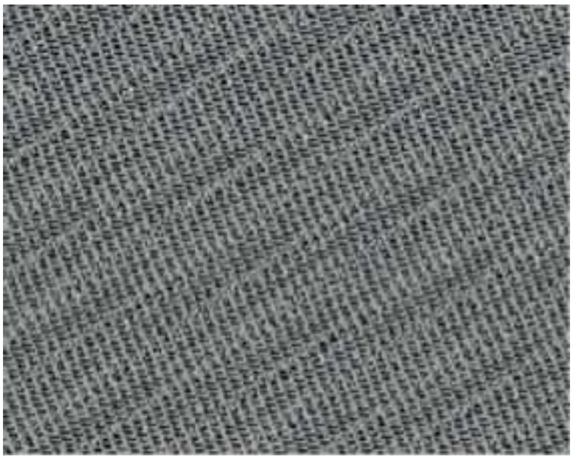

Fig. 3. Scrambled image

Fig.4. Recovered image

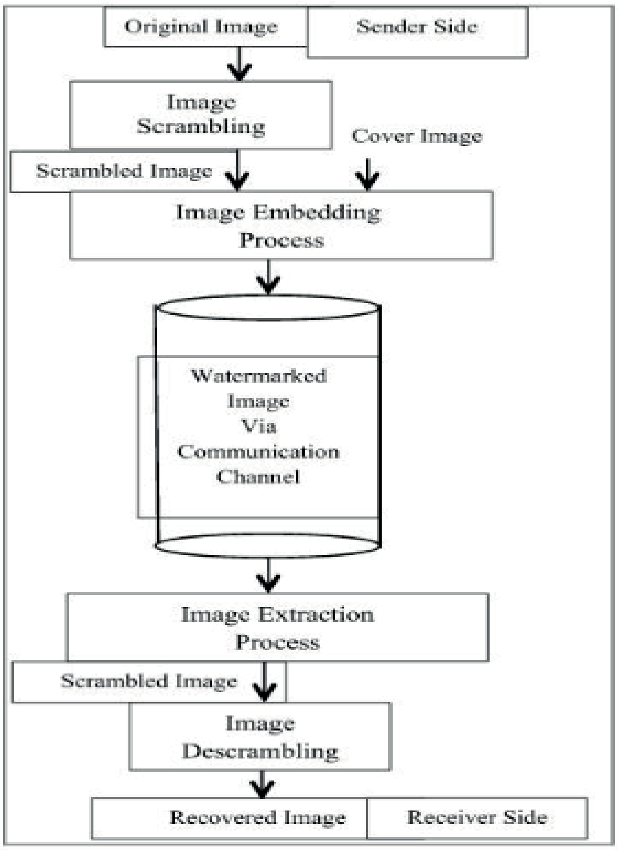

Fig. 5. Shows the image scrambling process

At sender side:

1) Reads cover image and original image
2) Scrambles original image using scrambling technique
3) Embed the scrambled image into cover image to get water marked image
4) Watermarked image is transmitted through communication channel to the receiving end

At receiver side

1) With the extraction process scrambled image from water marked image is extracted
2) With the descrambling process recovered image is obtained from scrambled image [5]

IV. CONCLUSION AND RESULT

By this affine transformation images are not only scrambled but they can be kept hidden and compressed in desired form. The above mentioned encryption have advantages such as security, performance, less noise, etc..But in block based transformation if the criteria is identified then the hacker can decrypt the image, so in our proposed work we just introduced an idea what we can do with affine transformation and how it is best with other traditional transformations. In this paper we have shown how image can be scrambled, hide, rotate, scaled,

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translate and contrast stretched. This transformation overcomes the drawbacks and limitations of previous transformation.

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