# Picrypt - Inscribe Images with Encrypted Texts

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**Abstract**

Inspired by the idea "why to send less, when you can send more", Picrypt is user-friendly, click-to-go-like software with a clean and simplistic user interface, which allows users to inscribe digital colour images with encrypted messages while preserving the original properties and qualities of the image. This image containing the encrypted message then can be downloaded and saved locally, and can even be shared to anyone across the globe digitally, while the data/message remains protected and preserved throughout. The passcode with which the messages are inscribed acts as the key for the successful decryption of the messages inscribed within. A detailed description of the software including the enciphering and deciphering of the messages has been presented in this work. The basic principle behind the software rests on using the state of pixel intensity values of a color image for inscribing textual data, encrypted with popular encryption methods like Vernam Cipher and Playfair Cipher, into the image pixel-by-pixel.

## 1. Introduction

Billions of images are shared among people every day. Sometimes, however, we often require sharing a description of the image as well. For example, a journalist often has to report to their higher authorities with a detailed description of the situation, along with the corresponding photographs. Picrypt

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brings up a method that does not require sending the description of the image separately, rather, the image itself could be inscribed with its description, or any other message, which then can also be locked with a passcode, to protect the message from being read by the unintended users. Thus, the journalist now just can inscribe the image with its description, and just need to share the image with the higher authority. There is also no scope for the data to reach unintended authorities, since the data in the image is password-protected, there is no way that unintended authorities can access the data inscribed within the image.



Picrypt has proved to be a simple, button-based, click-to-go mechanism-based software, which allows its users to inscribe images with texts, with few mouse clicks. Picrypt comes pre-packed with all the required dependencies for inscribing an image with password-protected texts. Picrypt also facilitates the decryption of images for the inscribed message with the correct password.

In the backend, Picrypt uses the state of pixel intensity values of a color image for inscribing encrypted data into the image pixel-by-pixel, while preserving the original components, details, quality, and aspect ratio of the image. No raw data is inscribed into the image, rather, the data is encrypted with Vernam Cipher [1] [2] and Playfair Cipher [3] [4] [5] before inscribing. An odd/even parity [6] check is also implemented in order to maintain the consistency of the data.

## 2. Background

A digital color image [7] is a digital image that includes the color information for each pixel. For visually acceptable results, it is necessary to provide three samples or color-channels for each pixel, which are interpreted as coordinates in some color space. The RGB or Red-Green-Blue color space is commonly used in computer displays, but other spaces such as YCbCr, HSV, and are often used in other contexts. A color image has three values (or channels) per pixel that measure the intensity and chrominance of light. The actual information stored in a digital image data is the brightness information in each spectral band. A digital color image [7] can be mathematically considered as a three-dimensional array of pixel intensities ranging from 0 to 255. Picrypt intends to perform slight (almost negligible) modulation to the entries in its array for inscribing text messages into the image. While decrypting, these changes can be however backtracked to extract the

message inscribed initially.
Picrypt also assures password-protected message encryption. The text to be inscribed is encrypted using Playfair Cipher [3] [4] [5]. Picrypt also offers the user to lock the image with an alphanumeric passcode taking Vernam Cipher [1] [2] into account. The user interface is simple, modern, and addresses all the required criteria for efficient human-computer interaction [8] [9].

## 3. Proposed Methodology



A digital color image [7] can be mathematically considered as a three-dimensional array of pixel intensities ranging from 0 to 255. Considering a color image of size $M \times N$, for the ease of computation, Picrypt first converts this three-dimensional image [10] array of size $M \times N$ pixels, into a vector of size $M \times N \times 3$ (Image Vector) in row-major form, as shown in Figure 1.

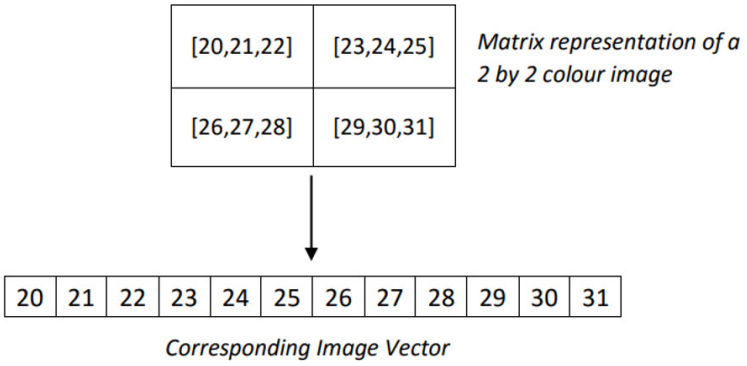


Figure 1: Translation of 3D Array into 1D Vector [10]

In order to inscribe a message into the image, Picrypt relies upon the odd/even [6] brightness intensity values in the one-dimensional representation of the image. Each even element is considered as a zero and each odd element is considered as a one. Thus, the image vector is passed through a function pre-process that decrements all the odd values in the image vector by one.

Every consecutive eight positions are considered as a single block, and for each block, each odd element is considered as a one and each even element is considered as a zero. The representative view of an arbitrarily Inscribed Image Vector is shown in Figure 4. For inscribing a particular string to the

```
Algorithm Pre-process (Image_Vector) {
        For each element E in Image_Vector {
                If E is Odd then {
                        Replace E with E – 1;
                }
        }
}
```

Figure 2: Pseudo code of Pre-Process function



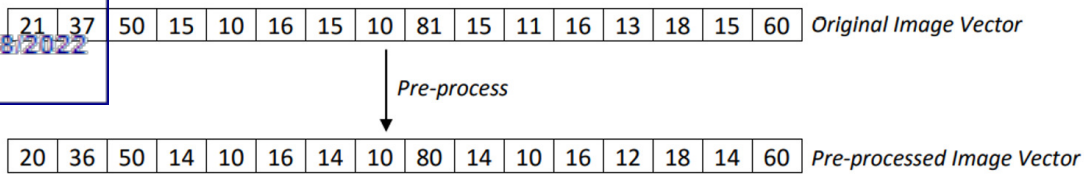


Figure 3: Applying Pre-Process function to an arbitrary Image Vector

image, the function INSCRIBE is taken into consideration. The pseudo code of the function is provided in Figure 5.

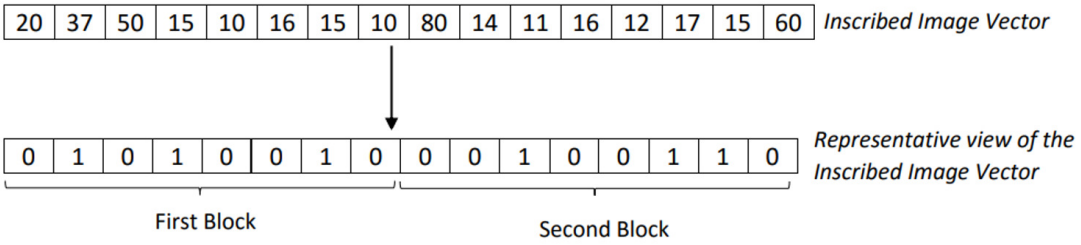


Figure 4: Representative view of an arbitrarily Inscribed Image Vector

Finally, the Image Vector is then reshaped to the dimensions $M \times N \times 3$ and then saved as a Portable Network Graphics (.png) file into the hard drive of the computer.

Picrypt also assures password-protected message encryption. For this, it offers the user to lock the image with a five-character alpha-numeric passcode. This passcode, however, is not inscribed within the image along with the text

```
Algorithm INSCRIBE (Image_Vector, Start_Index, End_Index, String, Str_Index) {
        If Str_Index > size(String) or End_Index > size(Image_Vector) then {
                Return;
        }
        B = Eight_Bit_Binary(String[Str_Index]);
        Image_Vector[Start_Index : End_Index] += B;
        INSCRIBE (Image_Vector, Start_Index + 8, End_Index + 8, String, Str_Index + 1);
}
```

Figure 5: Pseudo code of INSCRIBE function



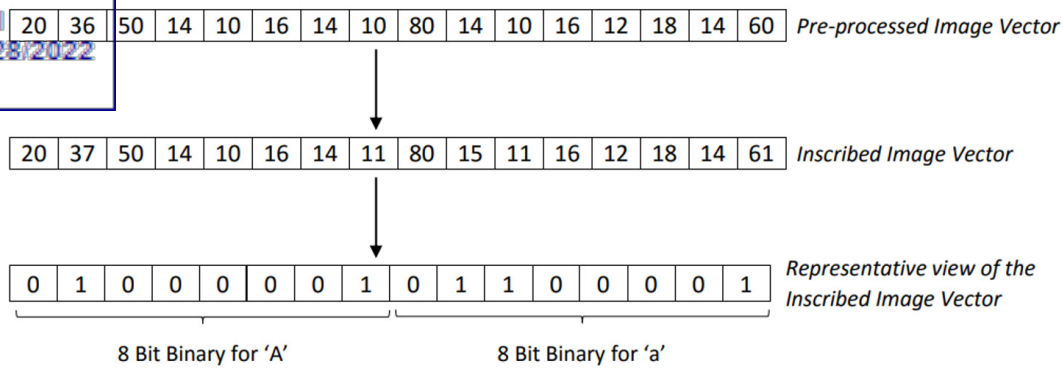


Figure 6: Representative view of an arbitrarily pre-processed Image Vector, inscribed with the string "Aa" using INSCRIBE function

message. Rather, a five-digit signature is stored in a specific location within the image. This signature is first encrypted using Vernam Cipher [1] [2] by the user-selected passcode. Thus, the user-selected pass-code acts as the key for decryption of the signature. At the time of decryption, Picrypt asks the user for the five-digit passcode, which is then used to decrypt the encrypted signature stored within the image's pixels. If on decryption, the decrypted signature does not match with the original signature, the software stalls any further decryption, as either the passcode provided is wrong or the data stored within the image is corrupted. Moreover, in order to achieve utmost protection, the message itself is encrypted with Playfair Cipher [3] [4] [5] before inscribing into the image.

Picrypt also provides a Strict Mode of data inscription, where, for an eight-element block of Image Vector, the last seven positions are used to store the data, and the first position is used as a parity [6] check for the data.

If, during decryption, Picrypt comes across any mismatch in the data and parity positions, Picrypt warns the user regarding the potential error in the decrypted data.
For reading the inscribed data from an image, the three-dimensional image array [10] is again reshaped into a single-dimensional vector. Similarly, every eight positions are considered as a single block and corresponding binary data is extracted, which are then translated into character. The data thus extracted is then decrypted and displayed to the user.



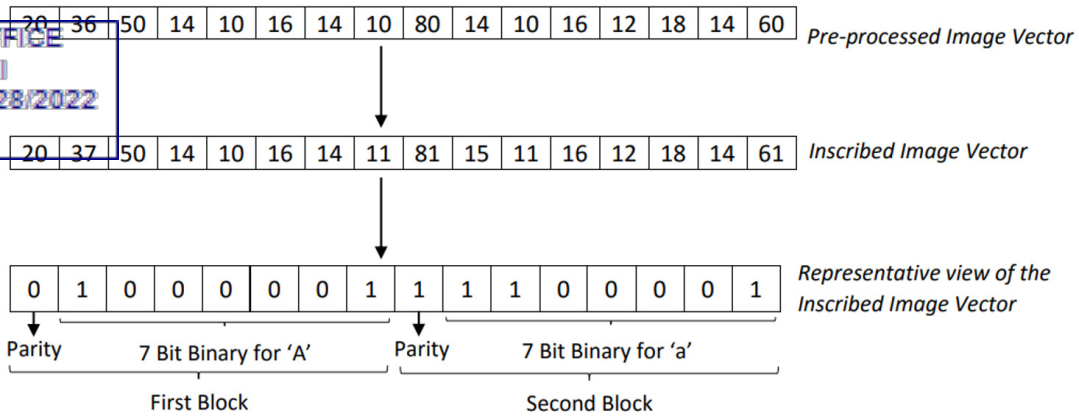


Figure 7: Representative view of Pre-Processed Image Vector inscribed with the string "Aa" in Strict Mode

## 4. Comparative study with the existing tools

Presently, there is no known popular tool that can offer to inscribe images with encrypted and password-protected text messages. Picrypt uses the states of pixel intensity values of a color image for inscribing encrypted data into the image pixel-by-pixel.
For a typical color image, which is inscribed with a password-protected message, the similarity between the original image and the inscribed image ranges from 99.50% to 99.99%, based on the Correlation Coefficient [11][12][13].

## 5. Discussions and Conclusion

An image inscription tool that aims to inscribe images with encrypted and password-protected texts is proposed in this work. The proposed tool uses the

state of pixel intensity values of a color image for inscribing encrypted data into the image pixel-by-pixel. The proposed tool is reliable, user-friendly, and has a clean and simplistic user interface. The data inscribed in the images are encrypted with Vernam Cipher and Playfair Cipher and is almost impossible to decrypt without the correct passcode. The technique proposed in this work can be a point of interest for researchers for maximizing the degree of similarity between the original and encrypted image using soft-computing techniques. As a future direction, the proposed technique can be applied for inscribing motion-images or videos with encrypted messages. Moreover, the technique can be included as a feature to popular chatting applications, which in-turn may change the complete process and purpose of sharing media among users.



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