Cryptography in Digital Watermarking - A Wavelet based Contrast Sensitivity

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Abstract— Development of compression algorithm for multimedia data such as MPEG – ¾ and JPEG standards increase in the network data transmission speed have allowed use of applications. Digital multimedia data are spread or manipulating. It is necessary to protect and secure the data (image). The embedded data into original data to make ownership can also be captured with encryption and decryption techniques. It provides a better content of transmitted data. The decrypted image is larger in size than encrypted or original image as it is being initiated through the proposed theory using MATLAB.

Keywords— E*dge detector, DWT, contrast sensitivity function*

1. Introduction

The aim is to embed copyright information on the robust digital water marking algorithms in transform domain. Anonymity is a technique to find ways to hide data content not all watermarking methods are suitable for particular application. The suitability of a method depends on the type of compression used, key type used. An objective and quantitative measurement on the suitability of each method for a given application is of great importance and usefulness.

Watermark should be resistant's to attacks that may remove it or replace it with another watermark. It should be transparent and perceptually invisible for image data. A digital watermark is a code robustly and imperceptibly embedded in the host data and typically contains information about origin, status and destination of data. A watermark is a secret signal embedded into the original data in a way remains present as long as the perceptible quality of content is at an acceptable level.

Channel techniques defined in the content of multilevel secure systems and handling properties of the communication channels in an unexpected and unforeseen way to transfer data through the medium without detection by anyone other than the entities operating covert channel. Digital watermarking has an extra requirement of robustness compared to steganography algorithms against possible attacks. It should be also noted that watermarking is not intended for protecting of the content of a message, and hence it is different from cryptography. The rapid evolution of multimedia systems and the wide distribution of digital data over the World Wide Web address the copyright protection of digital information. The aim is to embed copyright information, which is called watermark, on digital data (audio or visual) in order to protect ownership.

In general, a digital watermarking technique must satisfy two requirements. First, the watermark should be transparent or perceptually invisible for image data. The second requirement is that the watermark should be resistant to attacks that may remove it or replace it with another watermark. This implies that the watermark should be robust to common signal processing operations, such as compression, filtering, enhancements, rotation, cropping and translation.

Project Goals

Not all watermarking methods are suitable for a particular application. The suitability of a method depends on the type of data, the processing or transformations applied on data, the lossy or lossless type of compressions used, the key type used, etc.

- DWT
- Edge Detection
- Watermark Insertion
- CSF weighting
- IDWT

2. Digital watermarking

A. Introduction

A digital watermark is a form of steganography because it hides the embedded data, often without the knowledge of the viewer or user. A digital watermark is "a digital code robustly and imperceptibly embedded in the host data and typically contains information about origin, status, and/or destination of the data".

B. Classification of Digital Watermarking

The Digital Watermarking techniques can be classified into several ways.

- Visibility
- Robustness
- Capacity
- Perceptibility
- Embedding Method

D. Techniques of Digital Watermarking

- Spatial Domain Watermarking
- Transform Domain Watermarking

E. Applications of Digital Watermarking

For secure applications a watermark is used for following purposes:
- Copyright Protection
- Fingerprinting
- Broadcast Monitoring
- Data Authentication
- Copy Protection
- Covert Communication

For non-secure applications a watermark is used for following purposes:
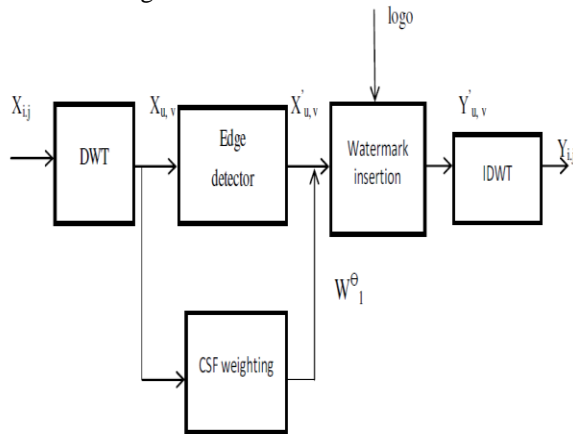- Indexing
- Medical Safety
- Data Hiding

Fig .1 Block diagram

3. Classification of compression techniques

A. Encoding

Encoding LSB method allows large amount of secret information to be encoded in an audio file. Audio file contains set of bytes which can be used for encoding. Some audio files may contain several bytes depending on their sizes.

The following steps were used during the encoding stage.
- Encrypt the message using a public key
- Convert the audio files into bit streams
- Convert each character of the message into bit stream
- Replace the LSB bit of the audio file with the LSB bit of character in the message to hide.

B. Decoding

Decoding In this stage, the encoded file is decoded to get the hidden message. The message is decoded first and then decrypted by the public key that is known only by the authorized receivers or users of the proposed system.

C. Encryption

Encryption During encryption, the user is allowed to enter a password/key in any combination of numbers, symbols and characters. The key contains set of characters, which are used to encrypt the message before encoding.

D. Decryption

Decryption The user's password/key is supplied to decrypt the encrypted message in order to get the original message. The processes of encryption and decryption are handled by DES (Data Encryption Standard) algorithm.
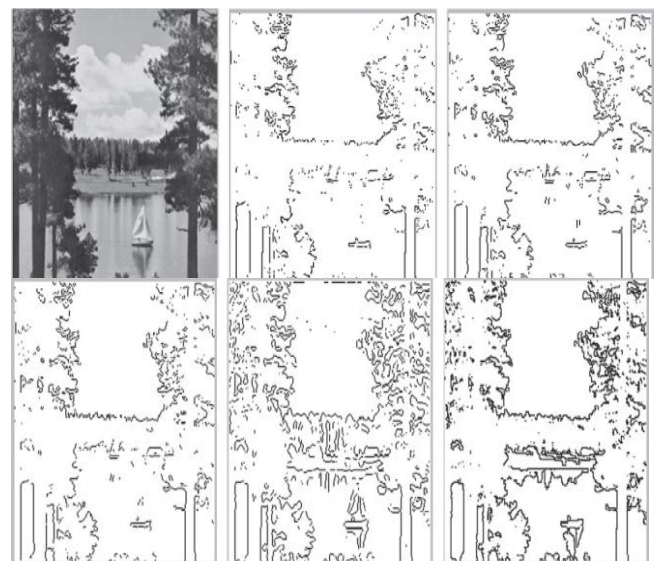

Fig.2: The Compression of image is possible using the image format from JPEG-2/4.

4. Discrete wavelet transform

The Wavelet Series is just a sampled version of CWT and its computation may consume significant amount of time and resources, depending on the resolution required. It is easy to implement and reduces the computation time and resources required if the signal, scaling functions, and wavelets are discrete in time, then the wavelet series of the discrete-time signal is called the DWT. The DWT of a sequence consists of two series expansion, one corresponding to the approximation and the other to the details of the sequence.
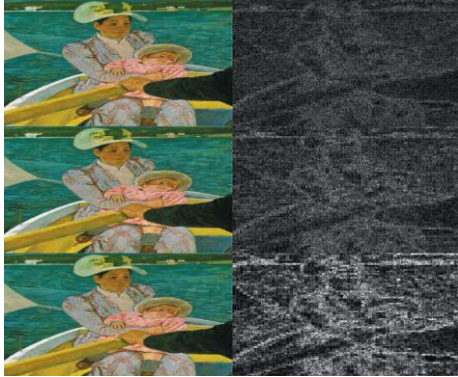
Fig .3: Water mark image based on DWT

5. Contrast sensitivity

Contrast sensitivity measures the ability to see details at low contrast levels. Visual information at low contrast levels is particularly important.

- In communication, since the faint shadows on our faces carry the visual information related to facial expressions.
- In orientation and mobility, where we need to see such critical low contrast forms as the curb, faint shadows, and stairs when walking down. In traffic, the demanding situations are at low contrast levels, for example, seeing in dusk, fog, rain, snow fall, and at night.
- In everyday tasks, where there are numerous visual tasks at low contrast, like cutting the onions on a light colored surface, checking the quality of ironing, pouring coffee into a dark mug etc.
- In near vision tasks like reading and writing, if the information is at low contrast as in poor quality copies or barely readable invitation etc.

Contrast sensitivity is the reciprocal of the contrast at threshold, i.e., one divided by the lowest contrast at which forms or lines can be recognized. If a person can see details at very low contrast, his or her contrast sensitivity is high and vice versa. Depending on the structure of the stimulus used in the measurement - either gratings of different size or symbols - contrast sensitivity of a person gets different values.

6. Existing system

- The suitability of a method depends on the type of data processing or transformations applied on data.
- An objective and quantitative measurement on the suitability of each method for a given application is of greater importance and usefulness.
- A watermark is a imperceptible signal embedded into the original data in such a way that it remains present as the perceptible quality of the content.

- It should be transparent or perceptually visible for image data and should be resistant to attacks that ay remove it or replace it with another watermark.
- The wavelet series is a version of CWT and its computation may consume significant amount of time and resource depending on resolution.
- The DWT is based on sub-band coding to compute a transformation of signal handling with a novel method had been existed.
- Increase in size is the drawback of an encryption strategy is the increase in size of the encrypted watermark, this issue can be resolved by adding another layer of lossless compression.
- Concluding, in future there are many aspects which still need to be investigated.

7. Proposed system

- Development of compression algorithms for multimedia data such as MPEG – 2/4 and JPEG standards increase in the network data transmission.
- Digital multimedia are spread everywhere with the possibility of duplicating of manipulating.
- It is necessary to protect and secure the data (image) to avoid illegal use of copyright issues.
- The embedded data into original data to make ownership can also be captured with encryption and decryption techniques providing better content of transmitted data.
- The encrypted image is larger than the normal image which is the major issues where it could be overcome by the concept of compression of the image before encrypting; it is being initiated in the proposed theory using software.

MATLAB, short for MATrix LABoratory is a programming package specifically designed for quick and easy scientific calculations and I/O. It has literally hundreds of built-in functions for a wide variety of computations and many toolboxes designed for specific research disciplines, including statistics, optimization, solution of partial differential equations, data analysis.
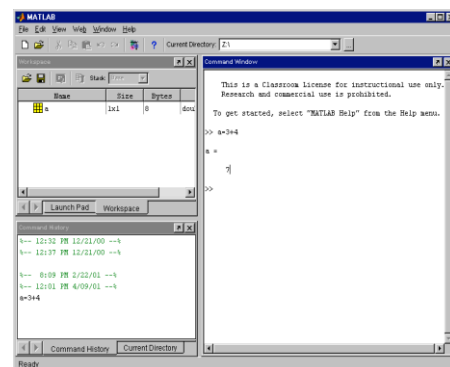

Fig .4 The MATLAB window

A.   Data representation in MATLAB

The MATLAB matrix-variables may have any number of rows and columns. Scalars like the variables a and b that you worked with above are also stored as matrix variables with 1 row and 1 column.

B. Entering variables

An mxn ('*m* by *n*') MATLAB matrix-variable (or simply variable) has *m* rows and *n* columns.
Generating variables
MATLAB provides functions to create several basic matrices automatically without having to type or read in each of the elements. The most important functions are

- Zeros zeros(m,n)creates an mxn matrix whose elements are equal to zero
- Ones ones(m,n)creates an mxn matrix whose elements are equal to one.
- Eye eye(m,n) creates an mxn identity matrix.
- Rand rand(m,n)creates an mxn matrix whose elements are random number between 0 and 1.

C. Logical expressions

MATLAB has 6 relational operators to make comparisons between variables.
   These are
                <is less than
                <= is less than or equal to
                >is greater than
                >= is greater than or equal to
                == is equal to
                ~= is not equal to
Note that the equal to operator consists of two equal signs and not a single = sign as you might expect.

D. MATLAB graphics

MATLAB has a large number of functions associated with graphical output. If you'd like to explore the possibilities use help plotter help plot3for 3-dimensional plots, or run the MATLAB demo (by typing demo) and look at the information on visualization and graphics.

E.GUI in MATLAB

MATLAB provides two ways of generating moving, animated graphics:
- On the fly - Continually erase and then redraw the objects on the screen, making incremental changes with each redraw.

- Frame by frame capture and playback - Save a number of different pictures and then play them back as a movie.
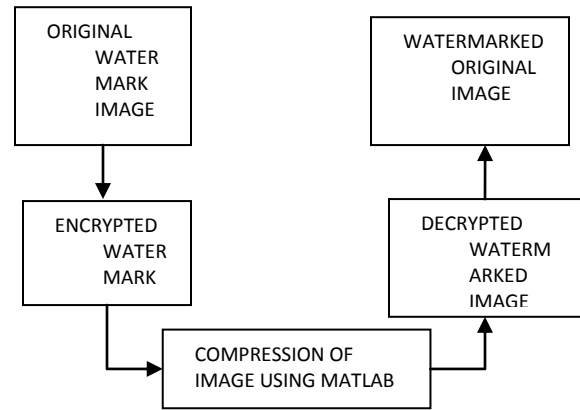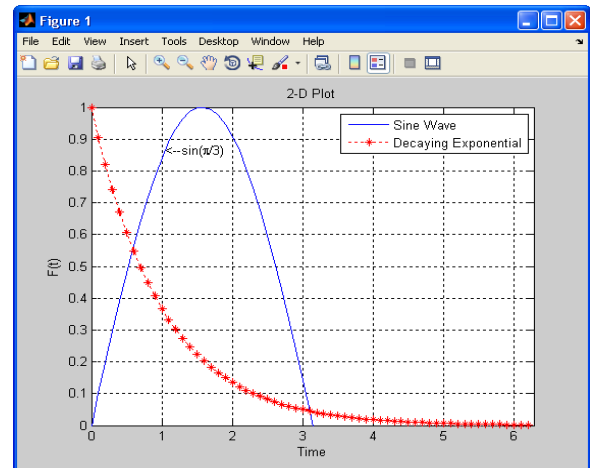

Fig.5: Flow Chart

Fig .6: Graphics

F. Image and Video

- Image I/O
        –imread, imwrite, iminfo
- Image display
        –image – Display
        –imagesc – Scale and display
- Image show
        –imshow – Display
        –subimage – Display multiple images in a single figure even if they have different colormaps
- Image exploration
        –imtool –Provides tools for pixel information, pixel region, distance, image information, adjust contrast, crop image, and display range
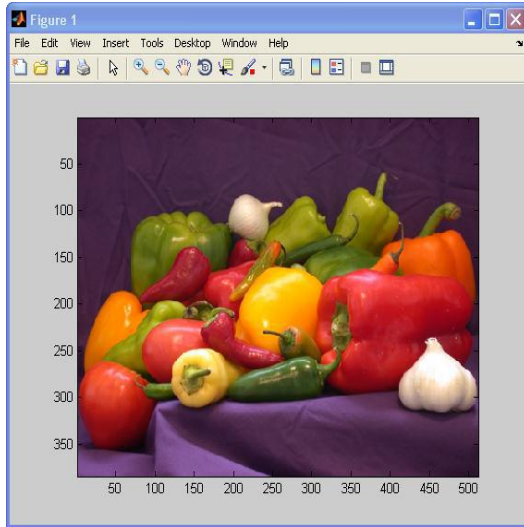
Fig.7 Display range of pixel units in image

Media Player(from Simulink) mplay - View video from MATLAB work space multimedia file, or Simulink model, Video reader & writer, Video Reader, Video Writer - Read and write video data from a file ,Replaces counterpart AVI function Video Reader replaces mm read video Writer supports 'Motion JPEG AVI', 'Motion JPEG 2000', Uncompressed AVI', 'MPEG-4' (H.264).
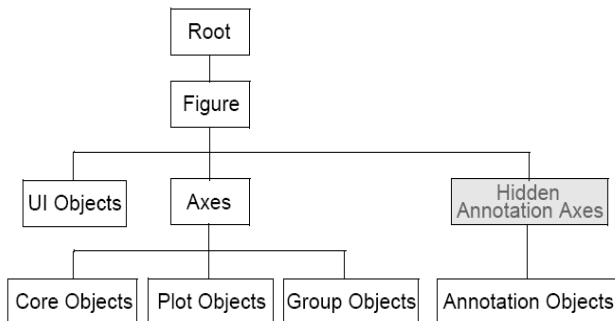Objects are organized into a hierarchy:
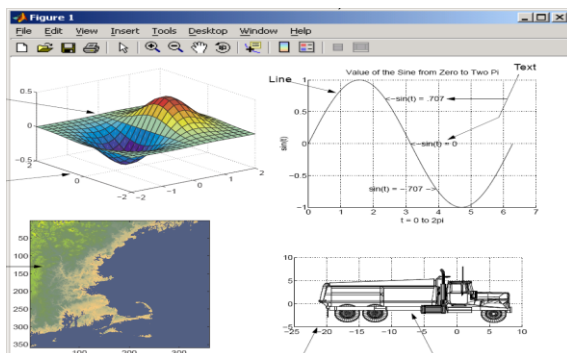

Fig.8: Graphics Objects Hierarchy

Fig.9: Core Graphics Objects

G .Creating a GUI

Typical stages of creating a GUI are:
- Designing the GUI
- Laying out the GUI
  –Using the Layout Editor
- Programming the GUI
  –Writing callbacks in the M-file Editor
- Saving and Running the GUI
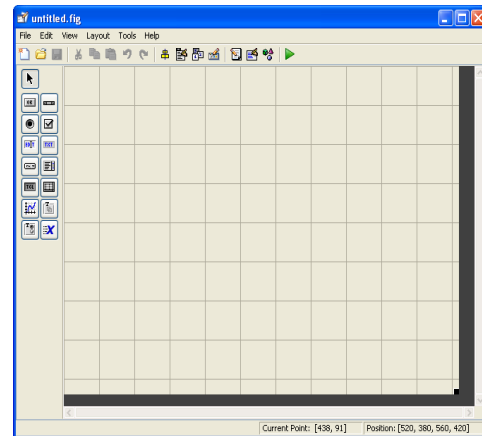
It is also possible to create a GUI programmatically.

Fig.10: The Layout Editor

H. Image Processing Modular Tools

Many of the interactive tools of the Image Processing Toolbox are modular and can be combined into your custom GUI
–For image processing applications
–Imcontrast, imcolormaptool, imcrop, imdisplayrange, imdistline, imageinfo, immagbox, imoverview,impixelinfo, impixelregion, impixelregionpanel, imsave, imscrollpane.

8. Conclusion

In this paper, a novel method for image watermarking has been presented. The method embeds the watermarking data on selected wavelet coefficients of the input image considering the CSF characteristics of the HVS. The selected coefficients reside on the detail sub-bands and describe the edges of the image. Thus, exploiting the HVS which is less sensitive to alterations on high frequencies, the embedded information becomes invisible. The evaluation of the proposed method shows very good performance as far as invisibility and robustness is concerned. The proposed scheme behaves very well in various common signal processing methods as filtering, compression, noise and cropping.

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