Appendix A

Publications

A.1 Complete List of Publications


4. Samir B. Patel and S. N. Pradhan “Proposed secure mechanism for Identification of ownership of undressed photographs or movies captured using camera based mobile phones” at the 2nd IEEE-International Conference on Digital Information Management ICDIM -2007 held at Lyon, FRANCE. pp no. 442-447


International Journal papers


A.2 Publications with Abstract


Abstract: Cameras attached to mobile phones are becoming more and more common, and as we move towards 3G and Next Generation Networks, it has become more a standard feature of mobile phones. Over recent months there have been a few grandiose claims within the media about the potential misuse of phones with camera capability. Unfortunately some of these claims are not proved by available facts resulting into confusion and misunderstanding. It may suffice to say that some digital cameras are smaller, convenient and technology superior in image quality. This makes them easier to use in an unacceptable manner. Camera phones are designed to provide a means of transferring images via your mobile phone to complement voice or text based communication for business or personal reasons. Normally the youth gets attracted towards the sexual photography and watching movies on the mobile devices. Sometimes such movies get broadcast on the network like wild fire and it is available to all the community. It is indeed a difficult task to identify the user who has captured these photographs or movies and made it public. This paper focuses on a technique through which this problem can be solved. This technique, if implemented, on a mobile phone can really help the concerned authority to identify the culprits.

URL: URL:www.mirlabs.org/jias/vol2-issue4.html

Abstract: Digital watermarking is an emerging copyright protection technology. The paper presents a new robust watermarking technique based on combining the power of transform domain technique, the Discrete Cosine Transform (DCT) and the data mining technique such as Decision Tree Induction (ID3). The paper focuses on a technique through which the notion of decision tree can be applied on transformed vectors to build the decision tree.

We train the image blocks for deriving the classification tree. The resulting decision tree provides decision making rules to identify good quality image blocks for insertion of watermark. The implementation results have shown that the algorithm has an acceptable robustness against the JPEG compression and addition of noise.

Keywords: Digital Watermarking, DCT, Arnold Transform, Data Mining, ID3, Security, Copyright protection.


Abstract: With the current development of multiprocessor systems, strive for computing data on such processor have also increased exponentially. If the multi core processors are not fully utilized, then even though we have the computing power the speed is not available to the end users for their respective applications. In accordance to this, the users or application designers also have to design newer applications taking care of the computing infrastructure available within. Our application is to use the CUDA (Compute Unified Device Architecture) as backend and MATLAB as the front end to design an application for implementing steganography. Steganography is the term used for hiding information in the cover object like image, audio or video data. As the computing required for multimedia data is much more than the text information, we have been successful in implementing image steganography with the help of technology for the next generation.

Keywords: CUDA, STEGANOGRAPHY, LSB.

URL: http://sites.google.com/site/ijcsis/vol-6-no-2-november-2009
http://www.doaj.org/doaj?func=abstract&id=474321

Abstract: With the tremendous amount of computing and because of the wide usage of the internet it is observed that some user(s) are not able to manage their desktop with antivirus software properly installed. It is happening few times, that we allow our friends, students and colleagues to sit on our networked PC. Sometimes the user is unaware of the situation that there workstations are unsecured and so someone else could also be monitoring your flow of information and your most important data could go haywire, resulting into leakage of most confidential data to unwanted or malicious user(s). Example of some such documents could be question papers designed by the faculty members by various universities. Now a day most of the universities are having the biggest threat about the question papers and many other confidential documents designed by their faculty members. We in this paper present the solution to overcome such a situation using the concept of steganography. Steganography is a technique through which one can hide information into the cover object. This technique, if used, in positive direction could be of great help to solve such a problem and even other.

Keywords: Steganography, DCT, LSB, Digital Watermarking.

URL: http://arxiv.org/abs/0912.0954

Abstract: Mobile camera was developed so that people do not have to carry any separate gadgets with them all the time, since it is integrated with their mobile phones; it helps in capturing images whenever and wherever wanted. But this mobile camera is also used for some wicked purposes i.e. nude photography followed by harassment to the individual. Hence there is an utmost need to prevent such type of happenings. We have tried to developed a module which will run when the image is saved in the memory or the file system of the mobile phone. It uses steganography to hide the IMEI, model number of the phone and the date on which the photograph is taken. When this image is forwarded via Bluetooth, the same module will get executed and the IMEI, model number and date on which image it is forwarded will be stored in the image. Objective of such an approach is to capture the original culprit or the ultimate source who captured the images or videos by backtracking and also the ones who helped in forwarding of such images and prevent such misuse of camera based mobile phones.
Appendix B

Prerequisite

B.1 DCT Basics

Formally, the discrete cosine transform is an invertible function $F : \mathbb{R}^N \to \mathbb{R}^N$ or equivalently an invertible square $N \times N$ matrix [16]. The formal definition for the DCT of two-dimensional sequence of length $N$ is given by the following formula [16]:

$$C(u, v) = \alpha(u) \alpha(v) \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} f(x, y) \cos \left( \frac{\pi(2x + 1)u}{2N} \right) \cos \left( \frac{\pi(2y + 1)v}{2N} \right) \quad (B.1)$$

The inverse of two-dimensional DCT for a sample of size $N \times N$ is given by:

$$f(x, y) = \sum_{u=0}^{N-1} \sum_{v=0}^{N-1} \alpha(u) \alpha(v) C(u, v) \cos \left( \frac{\pi(2x + 1)u}{2N} \right) \cos \left( \frac{\pi(2y + 1)v}{2N} \right) \quad (B.2)$$

We can separate equation $B.1$ in the following form:

$$C(u, v) = \alpha(u) \alpha(v) \sum_{x=0}^{N-1} \cos \left( \frac{\pi(2x + 1)u}{2N} \right) \left\{ \sum_{y=0}^{N-1} f(x, y) \cos \left( \frac{\pi(2y + 1)v}{2N} \right) \right\} \quad (B.3)$$

To perform the 2D DCT of length $N$, the cosine values are usually pre-computed offline. A 2D DCT is implemented on image by applying DCT on rows and columns of the input image by using equation $B.3$. So the whole 2D DCT process can be
represented in matrix notation using the following formula:

\[ C(u, v) = A^T X A \]  \hspace{1cm} (B.4)

### B.2 DWT : Discrete Wavelet Transform

The DWT inherently provides a multi-resolution image representation while also improving compression efficiency due to good energy compaction and the ability to decorrelate the image across a larger scale[124], [16]. DWT is important and computationally demanding part of JPEG2000 algorithm. JPEG2000 standard specifies use of LeGall (CDF) 5/3 DWT filter-banks for lossless compression process and Daubechies-Feauveau (CDF) 9/7 DWT filter-banks for lossy processing.

The basic idea of the wavelet transform is to represent any arbitrary function \( f \) as a weighted sum of functions, referred to as wavelets. Each wavelet is obtained from a mother wavelet function by conveniently scaling and translating it. The result is equivalent to decomposing \( f \) into different scale levels (or layers), where each level is then further decomposed with a resolution adapted to that level.

To do the wavelet transform on an image, we consider the \( n \) pixels in one row as level 0 approximation of a function. DWT decomposes image into a number of low and high sub bands at different levels of resolution. Two dimensional DWT is performed by applying the one-dimensional DWT row-wise and then column-wise in each component as shown in Figure B.1

In the first level of decomposition, four subbands LL1, HL1, LH1 and HH1 are created. Definition of these subbands is as follows:

- **LL**: low subbands for both row and column filtering.
- **HL**: high subbands for row filtering and low subbands for column filtering.
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Figure B.1: 2D DWT decomposition

- **LH**: low subbands for row filtering and high subbands for column filtering.
- **HH**: high subbands for both row and column filtering.

The low-pass sub band (LL1) represents the original component 2:1 sub sampled in both horizontal and vertical directions. It is a low-resolution version of the original component. The other subbands HL1, LH1 and HH1 represent down sampled residual versions of the original image necessary for the reconstruction of the original image. DWT can be applied on LL1 sub band repeatedly to produce four other subbands LL2, HL2, LH2 and HH2 with the same meaning as corresponding subbands originated in first step. The Figure B.2 shows 2-level 2D wavelet transform. DWT can be applied up to 32 times in the JPEG2000 standard. Nevertheless, more than five levels of decomposition do not bring any benefits.

There are basically 2 approaches to implement DWT.

1. **The convolution**: It performs series of dot products between the two filter
Figure B.2: Decomposition of Image

masks.

2. **The lifting scheme:** In this method odd sample values of the signal are updated with a weighted sum of even sample values, and even sample values are updated with a weighted sum of odd sample values.
APPENDIX B. PREREQUISITE

B.3 PSNR

PSNR stands for Peak Signal to Noise Ratio [16]. The designers of image processing methods require a standard metric to measure the quality of the reconstructed objects compared with the original ones. The better a reconstructed image resembles the original one, the bigger should be the value produced by this metric. As, we are performing transformation using DCT, there is a possible loss of data as bitwise check of results may fail, this is because of possible differences in floating point operations sequences in both implementations or due to differences in floating point units [16]. Therefore, for lossy transformation the consistency checking is performed using the objective image similarity metric PSNR. PSNR is defined for two images $I$ and $K$ of size $M \times N$ as:

$$
PSNR(I, K) = 20 \log_{10} \frac{MAX_I}{\sqrt{MSE(I, K)}}
$$

(B.5)

Where $I$ is the original image, $K$ is a reconstructed or noisy approximation, $MAX_I$ is the maximum pixel value in image $I$ and $MSE$ is a mean square error between image $I$ and $K$:

$$
MSE(I, K) = \frac{1}{M \times N} \sum_{i=0}^{M-1} \sum_{j=0}^{N-1} || I(i, j) - K(i, j) ||^2
$$

(B.6)

PSNR is expressed in decibel scale and takes on positive infinity for identical images. In image reconstruction typical values for PSNR vary within the range. PSNR value between 30 to 50 calculated from two images that were processed on diverse devices with the same algorithm says the results are practically identical.
Appendix C

Test Images

All the images shown in this part of text are scaled down to 65% of the original images.

Figure C.1: Lena Gray Scale [2]
Figure C.2: Barbara Gray Scale [3]

Figure C.3: Lena Color [4]
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Figure C.4: Sea Shore Color

Figure C.5: Cartoon Color Image [5]
Figure C.6: Sail Ship Color [6]

Figure C.7: Bridge Color Image [6]
Figure C.8: Sail Boat Color Image [7]

Figure C.9: Watermark Image