Enhanced Data Hiding Method Using DWT Based on Saliency Model

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What is Digital Watermarking?

Digital watermarking is a technique for inserting information (The Watermark) into an image, which can be later extracted or detected for variety of purposes including identification and authentication purposes.

Watermark

Motivation for Watermarking

- Intellectual property is important for the Internet
- Binary data is trivial to copy
- The web is a headache for copyright protection
- Many methods for free data exchange

"Watermarking is seen as the White Knight of copyright protection"

Way to Successful Watermarking

- Imperceptible :

  Affects the viewing experience of the image

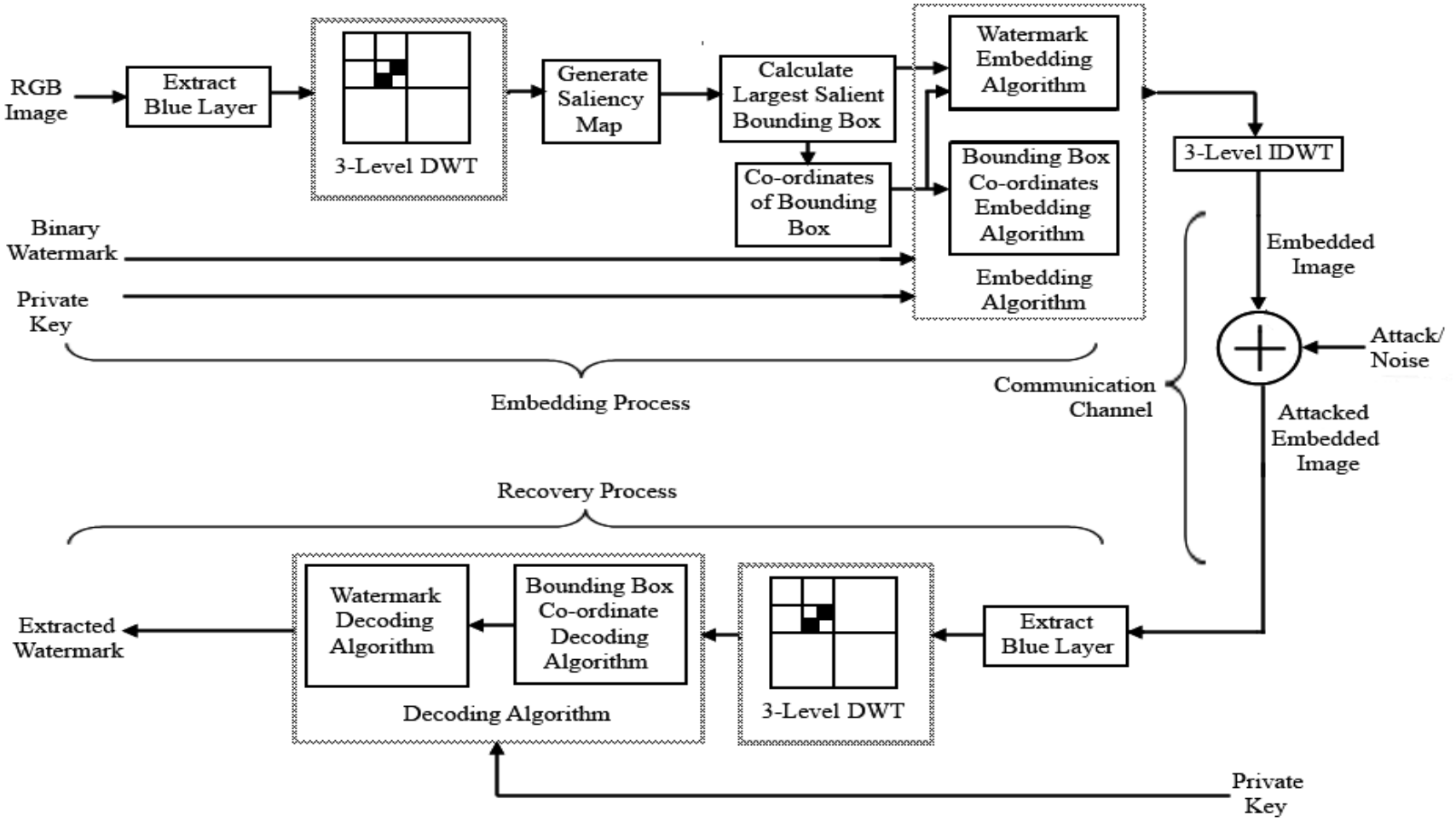
- Robustness :

  Survive under lossy compression and other signal processing attacks

- Unambiguous :

  Retrieval of watermark should unambiguously identify the owner, and the accuracy of identification should only degrade gracefully in the face of attack

Our Watermarking Model



Encoding Algorithm

- For encoding the watermark we have taken the help of both Discrete-Wavelet Transform and Saliency Map of the image so as to achieve an imperceptible watermarked version of the cover image.

Fig. Sample Watermarked Images

Encoding Algorithm (Contd.)

$$If \quad field\_bit(i) = 1,$$
$$\hat{H}_2(p) = H_2(p) + k_1 * PN\ sequence(p)$$
$$If \quad field\_bit(i) = 0,$$
$$\hat{H}_2(p) = H_2(p) \qquad (4)$$

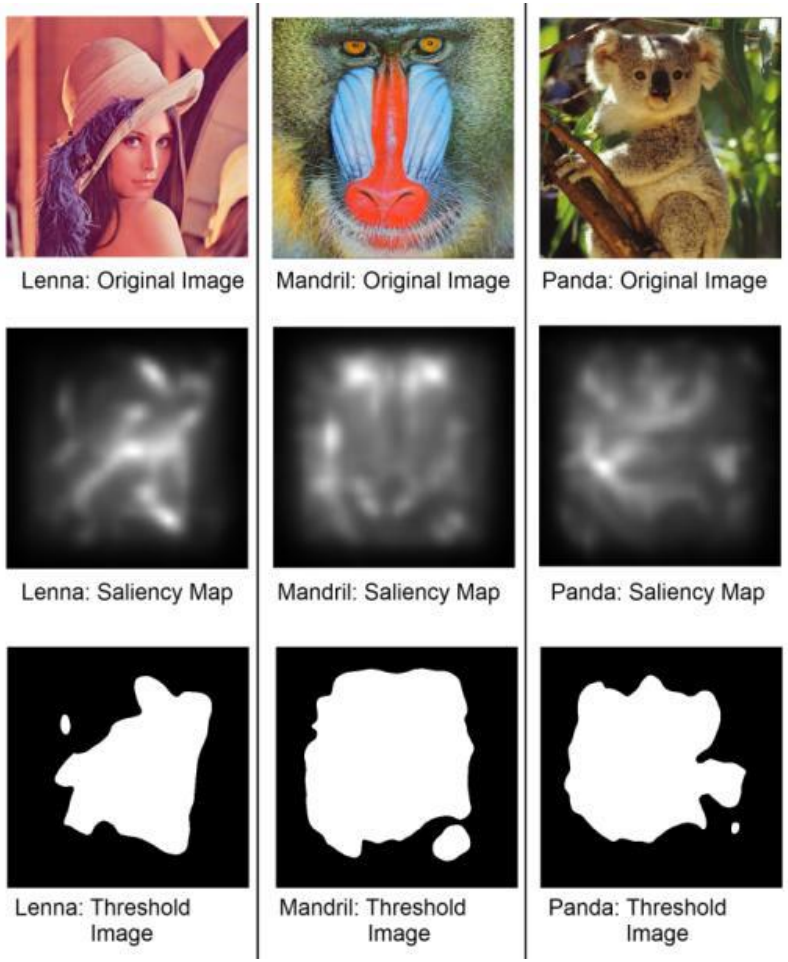
where, $1 \le i \le length(field\_bit)$ which is usually 8

$$\text{and } p = \begin{cases} 1 & field = x \\ 2 & field = y \\ 3 & field = width \\ 4 & field = height \end{cases}$$

$$If \quad watermark(i) = 0,$$
$$\hat{H}_3 = H_3 + k_2 * PN\ sequence$$
$$\hat{V}_3 = V_3 + k_2 * PN\ sequence$$

$$If \quad watermark(i) = 1,$$
$$\hat{H}_3 = H_3$$
$$\hat{V}_3 = V_3 \qquad (5)$$

where, $1 \le i \le length(watermark)$



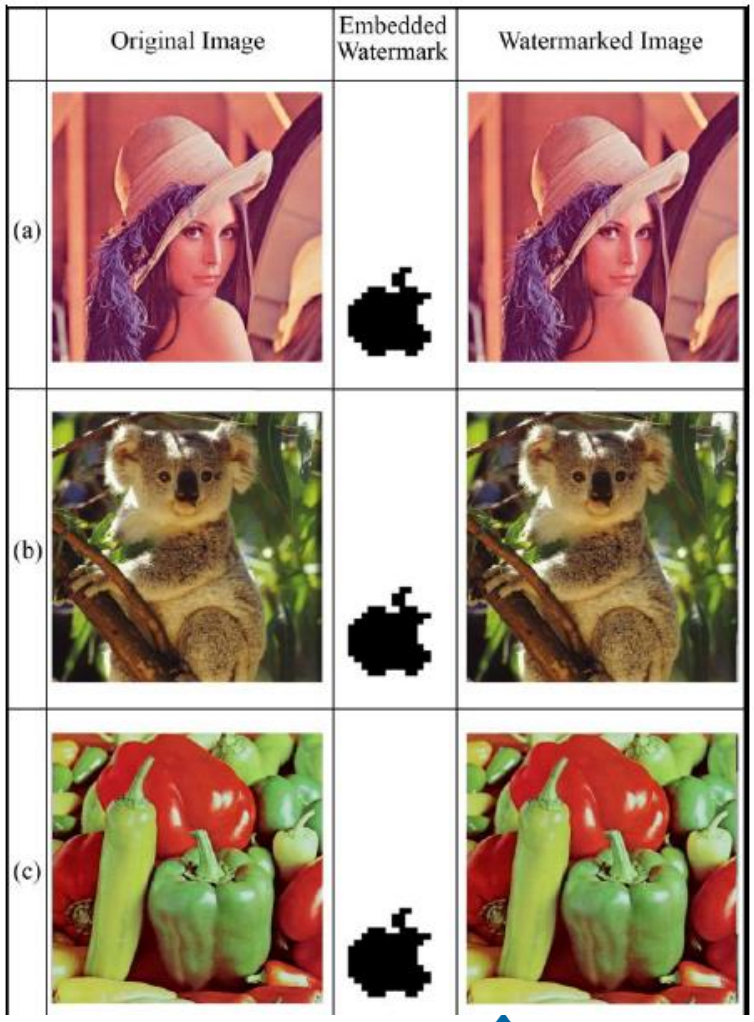
Problems Of Watermarking

- Copyright protection is big business - many attackers
- Internet spans continents and countries seamlessly
- Digital information is easy to copy
- Hackers are knowledgeable, creative, have lots of time, and are numerous
- Many attack opportunities
  - Few inventors, many attackers
  - Inventors despair after 3 years
- Human factors:
  - The default user does not understand watermarking
  - Human vision system is very robust to noise in images
  - Used to low quality in images (TV, strong JPEG compression)

Experimental Results

Visual Imperceptibility Analysis:

We have applied our embedding algorithm to different cover images to verify the effectiveness of our proposed method. We are showing results for four RGB images: 1) Lena, 2) Bear, 3) Peppers and 4) Sailboat, each having size of 512×512 pixels. All the watermarked images are visually imperceptible.

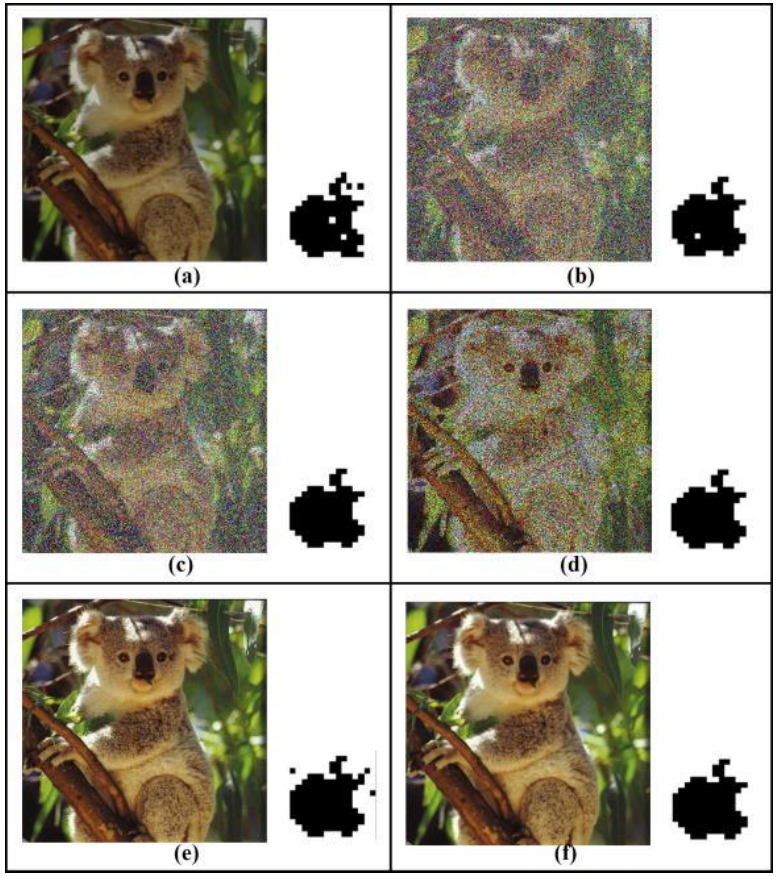


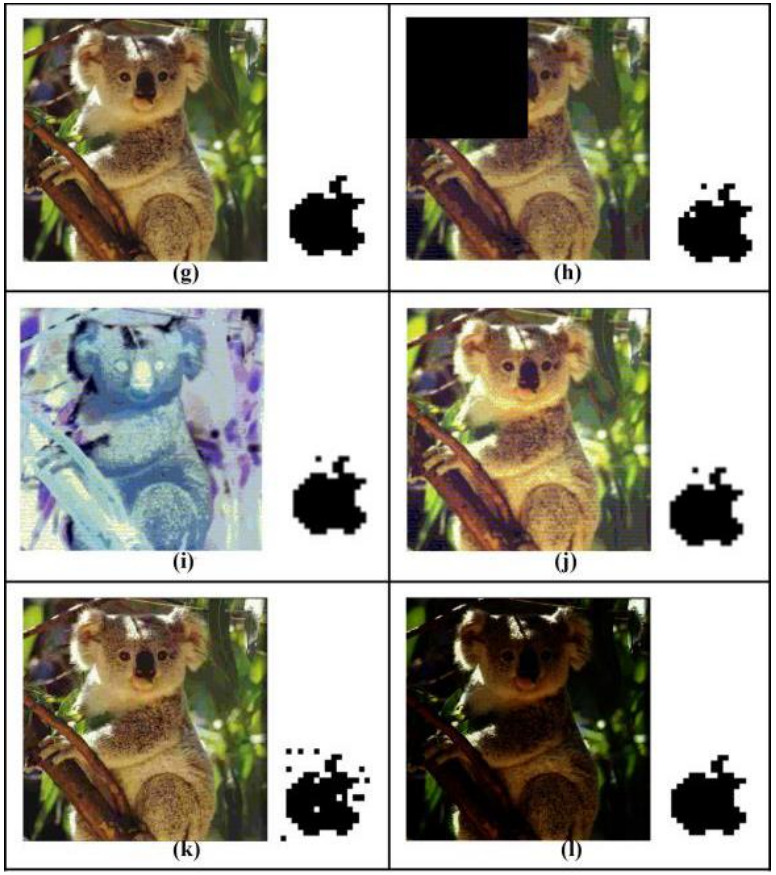
Watermark Attacks

- Active Attacks : Hacker attempts to remove or destroy the watermark.
- Passive Attacks
- Collusion Attacks : Hacker uses several copies of watermarked data(Images, Videos, etc.) to construct a copy with no watermark.
- Forgery Attacks

Experimental Results (contd.)

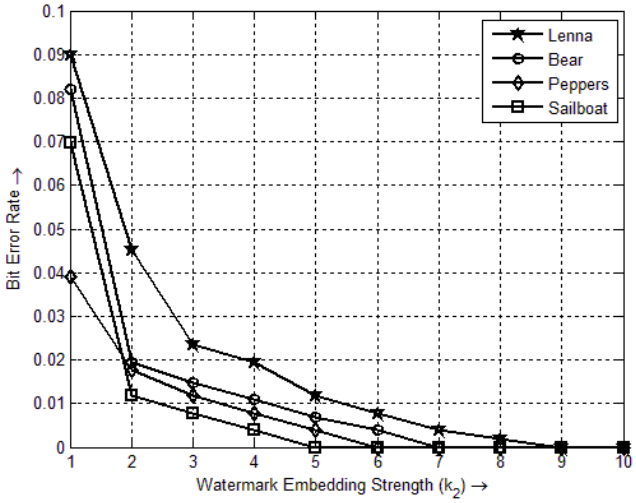
Robustness Analysis:

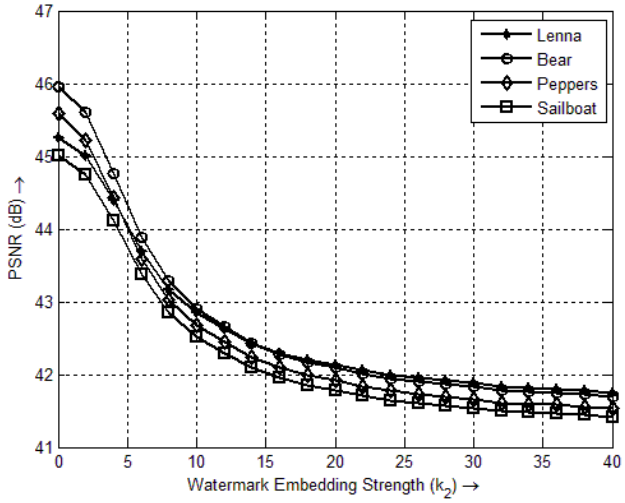


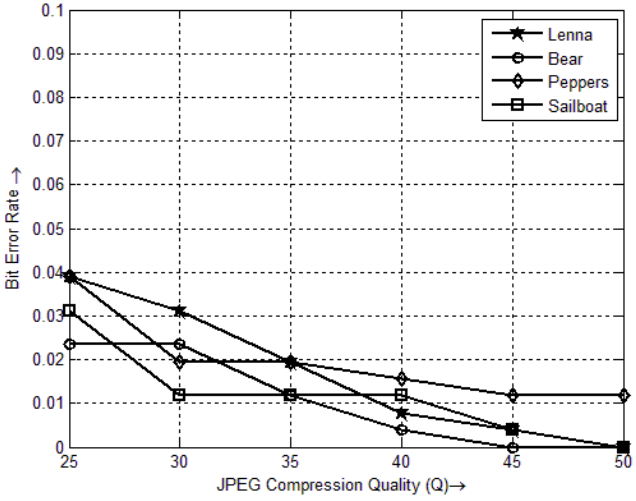


Experimental Results (contd.)

- Quality Analysis:

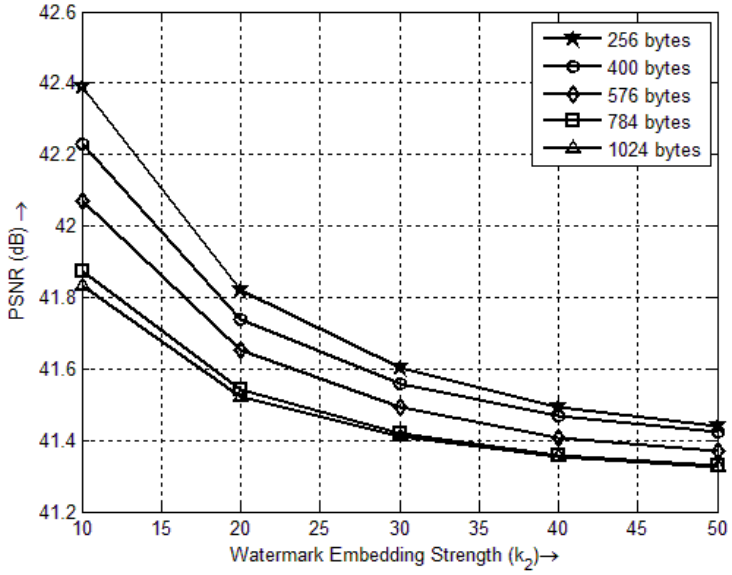


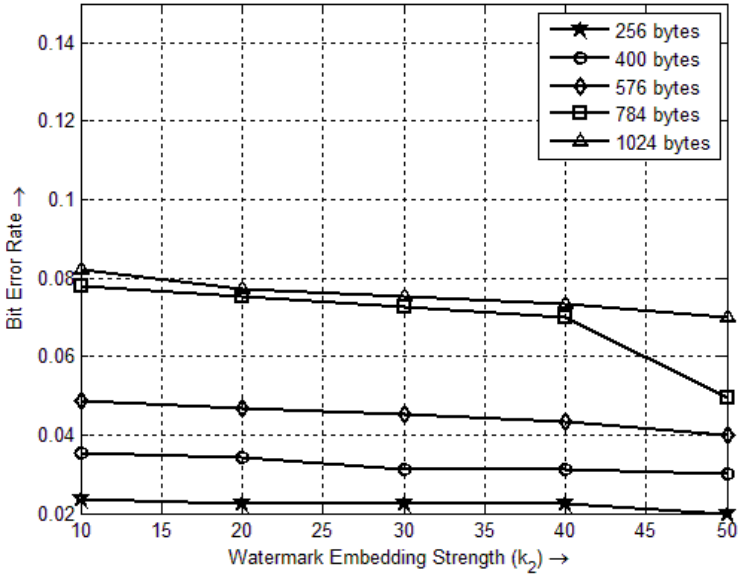




Experimental Results (contd.)

- Quality Analysis:





Experimental Results (contd.)

- Comparison with others algoritm:

Attack	Correlation		
	Our Method	Tian's method [14]	Mohanty's method [20]
No Attack	0.9980	0.9984	0.9947
Gaussian Blur	0.9890	0.8354	0.9856
JPEG Compression	0.9961	0.8124	0.7930
Median Filter	0.9841	0.9287	0.8373
White Noise	0.9922	0.9342	0.9286

Conclusion

- We enhanced the efficiency of the Saliency Map based watermarking model by combining the existing model with DWT based watermarking using CDMA technique.
- Our proposed method showed significant improvement in robustness and imperceptibility of the embedded image.
- It was believed that DWT implemented algorithms are not robust against Cropping, but we see that on combing DWT with Saliency Map of an image we are able to develop an algorithm that is robust against Cropping too.

References

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Questions