



Wrocław
University
of Science
and Technology

MULTIMEDIA AND COMPUTER VISUALISATION PROJECT

Analysis and comparison of hybrid image watermarking methods

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HR EXCELLENCE IN RESEARCH

Presentation plan

1. Theoretical introduction
2. Project scope and goals
3. Primary and secondary functionalities
4. Environment
5. Milestones & project plan
6. Questions

What is Digital Image Watermarking

Set of techniques utilised to embed markers or signatures in digital images, most often used for an ownership demonstration or copyright protection.

Applications of Digital Image Watermarking:

- copyright protection
- content authentication
- cover communication
- captioning

Characteristics of Digital Watermarking:

robustness security imperceptibility data payload fragility
computational cost false positive rate

State of Art

- Modern watermarking algorithms may operate in **spatial** or **frequency** domain
- **Ensemble methods** are gaining popularity nowadays
- Together with developing technology of acquiring images, especially in the medical field, watermarking methods must be constantly improved in terms of security and imperceptibility

Methods of digital image watermarking

DWT

Discrete Wavelet Transform is a partial transform and has the ability to multiscale analysis. Original image is decomposed into four sub-band images (three high frequency parts, called detail sub-images and one low frequency, called approximate sub-image). The detail sub-image contain the fringe information while approximate sub-image is convergence of strength of original image (majority of image energy concentrates here). DWT is very suitable to identify the areas in the host image where a watermark can be embedded effectively.

Methods of digital image watermarking

DCT

A Discrete Cosine Transform (DCT) is a widely used transformation technique in signal processing and data compression. DCT helps separate the image into parts of differing importance (with respect to the image's visual quality). Provides capacity of energy compression and decorrelation. DCT-based watermarking is based on two facts. The first fact is that much of signal energy lies in low-frequencies sub-band which contains the most important visual parts of the image. And second fact is that high frequencies are usually removed through compression and noise attacks. Therefore watermark is embedded by modifying the coefficients of the middle frequency sub-band, so visibility will be not affected and watermark will be not removed during compression.

Methods of digital image watermarking

SVD

Singular value decomposition is one of the effective tool to analysis the matrices. While using the SVD transformation a matrix is decomposed into three matrices U , D , V . SVD preserves both one-way and non-symmetric properties usually not obtainable in DCT transformation. One of big advantages of use SVD from perspective of digital watermarking is that: small perturbations in singular values does not change image significantly.

Project Scope

1. **Research** - analysis of scientific articles and process of getting to know popular watermarking methods.
2. **Design and implementation** of exact watermarking algorithms
3. **Simulation of different attacks** - assessment of various methods and their configurations
4. **Gathering outcomes**
5. **Comparison of gained data**
6. **Creation of final documentation**

Goals

Our goals are to:

- create an environment which will enable us to pursue the analysis of each pair of methods.
- comparison different transformation hybrids in relation to the obtained quality and resistance to transformation, distortion and compression.

Features of the project

Primary:

- Designing a programme with implementation of hybrid algorithms
- Creation of undetectable watermarks on pictures with the use of DWT-DCT hybrid
- Creation of undetectable watermarks on pictures with the use of DWT-SVD hybrid
- Extracting watermark
- Calculating PSNR of extracted watermark after different attacks

Secondary:

- Development of basic GUI
- Performance assessment of DWT, DCT, SVD

Techniques & Technologies



NumPy



pillow

Milestones & project plan

- 19.10 - research and discussions

20.10 - Project kick off

Presentation of our project plan, goals and steps we are going to take to reach them.

- 10.11 - watermarking methods implemented
- 24.11 - initial testing of algorithms
- 30.11 - prepared to present working product

01.12 - Presentation of the prototype

Presentation of implemented algorithms. Sum up of our previous work and few words about plans for gathering future data.

- 14.12 - performance assessment done (PSNR etc.)
- 01.01 - deadline for software testing and analyzing experiments results
- 11.01 - deadline for finishing documentation

12.01 - Presentation of final research

Sum up of whole project and presentation of the outcomes.

Responsibilities

- **Project supervision** - Aleksandra Wieczorkiewicz
- **Documentation supervision** - Aleksandra Wieczorkiewicz
- **Documentation** - entire team
- **Implementation of DWT-DCT hybrid** - Aleksandra Wieczorkiewicz, Kamil Nawrot
- **Implementation of DWT-SVD hybrid** - Kamil Brzycki, Jacek Zalewski
- **Software tests** - Kamil Nawrot
- **Simulated attacks supervision** - Kamil Brzycki, Jacek Zalewski
- **Implementation of image PSNR calculation tool** - Kamil Nawrot

Bibliography

- <https://www.researchgate.net/publication/301712559> State-of-the-Art in Techniques of Text Digital Watermarking Challenges and Limitations
- <https://www.researchgate.net/publication/26621646> Combined DWT-DCT digital image watermarking

Articles

- <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.299.7956&rep=rep1&type=pdf>
- <https://www.researchgate.net/publication/26621646> Combined DWT-DCT digital image watermarking
- <https://www.researchgate.net/publication/272747716> Digital Image Watermarking An Overview
- <https://www.researchgate.net/publication/26621646> Combined DWT-DCT digital image watermarking

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- Naveed, Asim & Saleem, Dr. Yasir & Ahmed, Nisar & Rafiq, Aasia. (2015). *Performance Evaluation and Watermark Security Assessment of Digital Watermarking Techniques*. Science International Lahore. 27. 1271-1276.
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Thank you for your attention!
Questions?