

# Low-cost Secure Image Trading System Based on Semi-Blind Fingerprinting Using Synthetic Transparent Images

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## 1. Project Goal

We are aiming at providing user-friendly security tools. Most of existing security tools is difficult to use in general. In this project, we focused on security for digital content. Secure enhanced digital watermarking such as privacy-secure watermarking is also complicated to use. For example, existing blind watermarking used for privacy-secure content trading composed of public key encryption and watermarking is lack of robustness due to incompatibility of watermarking and cryptography. We have established a concept of pseudo-blind watermarking which resolves the incompatibility of robustness by applying a media processing blinding method which has high compatibility with watermarking. We have also prototyped content trading system to verify the validity of pseudo-blind watermarking.

## 2. Technical breakthrough

The existing content security is either practical or extremely secure. However, the former one is lacking in security, the latter one has problem in feasibility. The middle range that satisfies security and feasibility isn't existing. Our proposal complements the gap between the former one and the latter one which satisfies both security and feasibility. In addition to the fulfillment of the gap, we have dedicated to provide usability.

Proposed practical and secure digital watermarking requires no special skills, tools or knowledge as shown in Fig 1. The scheme is briefly described below. Beforehand, a purchaser obtains a pseudonymous ID and then requests content.

1. If the ID was verified, a provider decomposes an image into unrecognizable piece and valueless piece. The former one is sent to TTP and the latter one is sent to the purchaser. At this point, the purchaser has no incentive to re-distribute the content because the content is valueless, and purchaser's information is not revealed to the provider because of pseudonymity.

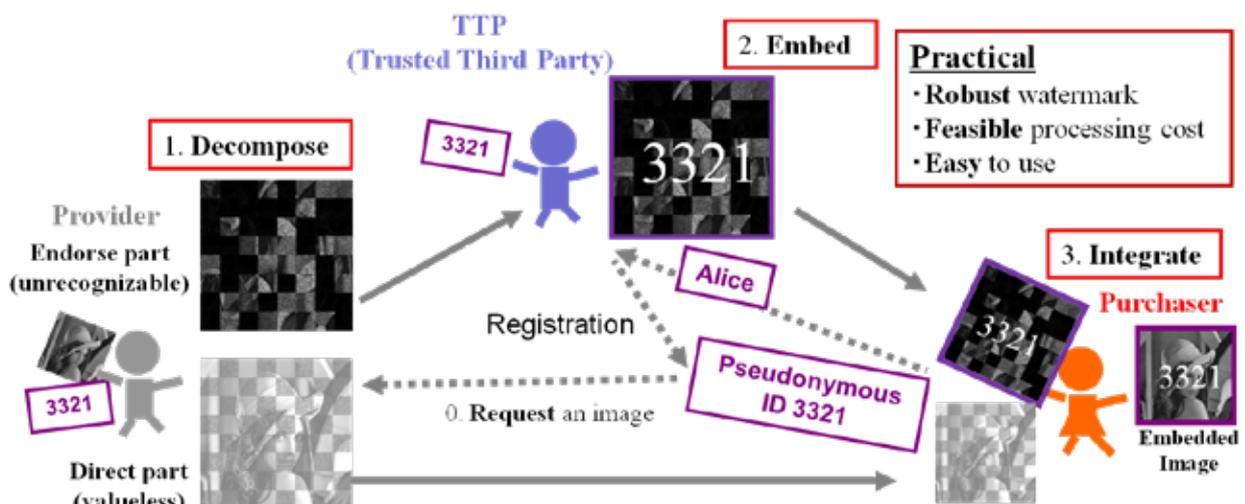


Fig. 1 Scheme of Pseudo-Blind Watermarking

2. TTP embeds the ID into the unrecognizable image. TTP has no clue as to what kind of content has been traded due to unrecognizability.
3. The purchaser integrates the images to obtain complete watermarked image.

A purchaser is able to obtain watermarked image without exposing privacy to the other parties. We have implemented easy integration process at step 3 and presented in CCNC2010 which has been awarded as best demonstration. The evaluation shows robustness of watermark embedded using pseudo-blind watermarking.

### 3. Innovative Applications

This technique may be used for eBook content. The scenario is described below. First, the client obtains a pseudonymous ID through the registration page provided by TTP. Second, the client login to the provider's webpage using the ID where an image can be purchased. The provider verifies the ID in cooperation with TTP. At this point, TTP

possesses the client's name and the pseudonymous ID while the provider only possesses the pseudonymous ID and purchasing history. Therefore, TTP cannot profile what kind of image has been purchased while the provider has no clue as to who the client is. Brief description is shown below.

1. The client moves to a web page where an image can be purchased by clicking one of the thumbnails.
2. Trading procedure which contains image decomposition and watermark embedding process are executed and then two decomposed images are generated.
3. Finally, the client receives these two images, endorse piece and complement piece from TTP and the provider respectively. The images are integrated to be a complete watermarked image as described later on.

Easy integration program is also provided in which semi-transparent image is overlapped one another as shown in Fig.2. Only web browser is needed to integrate the images instead of using an integration program. This integration is compatible to the tablet PCs.

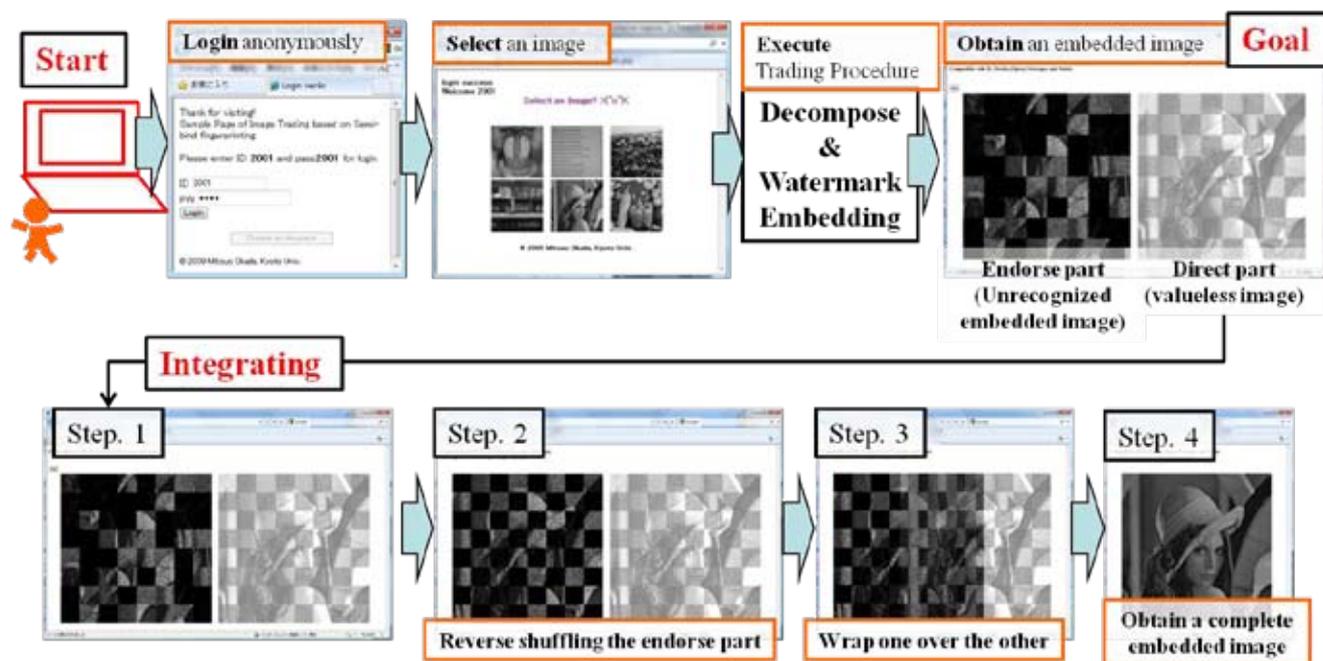


Fig.2 Scenario of Content Trading

We have also proposed a user-friendly digital watermark extraction method shown in Fig. 3 which can be adapted to the pseudo-blind watermarking scheme. Watermark in analog paper such as paper currency can be extracted by simply transmitting the light through the paper. On the other hand, most existing digital watermarking methods require an extraction program. However, ordinary people cannot verify the validity of an extraction program. Moreover, most of them are black-box in order to protect formerly embedded images which may be analyzed by reverse engineering. The proposed digital watermarking can be extracted by any people with no special skill, knowledge, nor tools. Only a web browser without JavaScript or Flash, and a filtering image are needed. We have evaluated robustness and perceptual evaluation of the proposed method which provide an effective result. Watermark is extracted by overlapping converted semi-transparent image to the watermarked image. When the image is overlapped, the modified pixels appear as contrast.



Fig. 3 User-friendly Watermark Extraction

## 4. Academic Achievement

We have been extending our research to academic researches as well as industrial products as summarized below.

- "User-friendly Digital Watermark Extraction using Semi-transparent Image" presented in CCNC2011 with explicit acknowledgement to the MSRA is posted on IEEE Spectrum ( <http://spectrum.ieee.org/tech-talk/telecom/security/user-friendly-steganography> ) on Jan 2011. The previous topic, "A Web-based Privacy-Secure Content Trading System for Small Content Providers Using Semi-Blind Digital Watermarking", presented in CCNC2010 was awarded as best demonstration.
- Journal of "Proposal on Pseudo-Blind Digital Watermarking" is submitted to ISCIE with acknowledgement to the MSRA.
- Preparing doctoral dissertation, "Asymmetric and Pseudo-Blind Digital Watermarking for Fair and Privacy-

Secure Digital Content Trading" with acknowledgement to the MSRA.

## 5. Project Development

The project is on going with the support from grant provided by JSPS.

## 6. Publications

### Paper publication

List of publication and achievement to date:

- 1) Mitsuo Okada, Sakito Matsuyama, Yoshinori Hara, User-friendly Digital Watermark Extraction using Semi-transparent Image, IEEE-CCNC2011, 2011. (with the explicit acknowledgement)

Publications in the future.

- 2) Book chapter in INTECH - Open Access publisher, "Digital Content Security:" (will be published in Dec 2011)
- 3) Journal: "Proposal on Pseudo-blind watermarking."

### Other Publication

Other publications in next two years

- 1) Presenting a new Captcha technique for mobile tablet devices, international conference and journal.
- 2) Demonstrating a topic of the new Captcha in IEEE-CCNC2012.