



Faculty Of Information And Communication Technology

**PDF DIGITAL WATERMARKING: GRAYSCALE
PHOTOCOPY DETECTION OF PRINTED
DOCUMENTS**

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MSc. in Information and Communication Technology

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**PDF DIGITAL WATERMARKING: GRAYSCALE PHOTOCOPY DETECTION OF
PRINTED DOCUMENTS**

SOONG HOONG CHENG

**A thesis submitted
In fulfillment of the requirements for the degree of Master of Science
in Information and Communication Technology**

Faculty Of Information And Communication Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2010

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I certify that I have read this dissertation and that, in my opinion, it is fully adequate in scope and quality as a dissertation for the Degree of Master of Science in Information and Communication Technology.

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(Principal Supervisor)

I certify that I have read this dissertation and that, in my opinion, it is fully adequate in scope and quality as a dissertation for the Degree of Master of Science in Information and Communication Technology.

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ABSTRACT

Digital watermarking is a growing research area to mark digital content (image, audio, video, etc.) by embedding information into the content itself. As a result, this technique provides additional and useful features for many application fields. In addition, digital watermarking is also used to provide additional and useful evidences for many application fields especially in copyright infringement detection. For this reason, this research focuses on PDF watermarking and the printed watermarked copy. Apart from the security purpose, it is known that the grayscale photocopied documents are easily duplicated. Therefore, the objective of this research includes identifying the most suitable color that can be used in order to overcome the illegally grayscale photocopied documents. As to get the most suitable color to achieve the objective, a test model is developed to proof that yellow color is suitable to be employed for detecting the duplicated grayscale photocopies easily. Colour theory and colour properties are used to prevent yellow-watermarked authentic stamps that are being photocopied in grayscale, particularly by using luminance concept on the documents to detect illegal grayscale photocopying. The research applies only for grayscale photocopies, as the detection for coloured copies requires disparity techniques for the coloured detection. Based on the disparity techniques, further research if possible, will be conducted for the coloured hard-copied documents.

ABSTRAK

Sesungguhnya, tanda air digital merupakan salah satu bidang kajian yang berkembang pesat dimana kandungan fail digital seperti gambar, audio, atau video ditambah maklumat lain supaya sesuatu dokumen mudah ditentukan kesahihannya. Oleh yang demikian, tanda air digital adalah teknik untuk menyediakan bukti-bukti tambahan pada pelbagai aplikasi dan berguna terutama sekali dalam pengesanan cetak rompak. Namun demikian, tumpuan kajian penyelidikan ini berfokus kepada menambah tanda air pada dokumen berformat PDF dan hasil pada salinan bercetak beserta dengan tanda air tersebut. Selain daripada tujuan keselamatan dokumen, sememangnya tidak dapat dinafikan bahawa dokumen tersebut dapat disalin dengan mudah sekali dengan pencetak analog hitam putih (fotostat). Oleh itu, penyelidikan ini mempunyai matlamat untuk mengenal pasti warna yang paling sesuai untuk diaplikasikan sebagai tanda air untuk mengatasi masalah penyalinan dokumen tanpa kebenaran melalui mesin fotostat analog hitam putih. Untuk mengenal pasti warna yang paling sesuai, objektif kajian ini akan tercapai dengan pengenalan warna kuning didapati paling sesuai dalam pengesanan pencetakan hitam putih di samping diuji dengan satu model pegujian yang dibangunkan. Bagi menjejak dan mengesan dokumen bercetak yang asal dan tulen, teori warna dan ciri-ciri warna telah digunakan di mana didapati bahawa warna kuning tidak dapat disalinkan melalau pencetak analog hitam putih dengan mengaplikasikan konsep kecerahan pada warna. Kajian ini hanya diaplikasikan untuk pengesanan pencetakan hitam putih disebabkan pengesanan daripada pencetakan bewarna memerlukan teknik yang amat berbeza. Natijahnya, kajian penyelidikan lanjutan jika perlu dilaksanakan bagi mengesan penyalinan dokumen menggunakan pencetak warna.

ACKNOWLEDGEMENT

Prior to being awarded the master degree, I am one of the students from Universiti Teknikal Malaysia Melaka (UTeM) who are required to prepare a research within a certain period of time. The reason for the research to be carried out is to train students to be exposed to the actual working environment before facing real challenges during their career days. Not only capable and competent to apply the knowledge skills acquired during the researches, the assessment can be carried out during consultations with the supervisors to identify the current level of knowledge gained by the students. Hence, rooms for improvement still can be prepared for the upcoming workforce upon completion of the studies. Further than that, with the incessant researches during the practical development obliquely will improve the soft-skills either by the reports or social relationships among colleagues in an organization. As for this, I am grateful to UTeM to provide such paramount facilities and services prior completing my master's degree project. As a token of appreciation, I would like to express my fullest gratitude towards my supervisor Associate Professor Norhaziah Md. Salleh (main thesis supervisor), Professor Dr. Nanna Suryana Herman (co-supervisor) and Massila Kamalrudin (research assistant supervisor) for the enthusiasm as guiding me to carry out my duty as a researcher during the practical days in the university. Apart from that, I am grateful to my beloved parents for the invaluable advices and the moral support guiding me to the right objectives to accomplish the research project. Last but not least, gratefulness is shown to my colleagues for the infinite moral support during my predicament in UTeM. As for the staffs in UTeM, thank you for giving warmth welcome and priceless advices to me.

DECLARATION

I declare that this thesis entitled "PDF Digital Watermarking: Grayscale Photocopy Detection of Printed Documents" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any degree.

Signature :

Name :

Date :

DEDICATION

Dedicated to my beloved parents, to my friends and to my lecturers/supervisors for their
support and encouragement

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LIST OF ABBREVIATIONS

| | | |
|---------|---|---|
| 2-D/3-D | - | 2-Dimensional/3-Dimensional |
| API | - | Application Programming Interface |
| ASP | - | Active Server Pages |
| CASE | - | Computer-Aided Software Engineering |
| CD/DVD | - | Compaq Disc/Digital Video Disc |
| CIE | - | Commission Internationale de l'éclairage |
| CIELAB | - | CIE L (Lightness) a* b* (Colour-Opponent Dimension) |
| COM | - | Component Object Model |
| CS | - | Creative Suite |
| CUBIC | - | Cubic Electronic Sdn. Bhd. |
| CYMK | - | Cyan, Yellow, Magenta and Black |
| DBMS | - | Database Management System |
| DDR | - | Double Data Rate |
| DFD | - | Data Flow Diagram |
| DMS | - | Digital Management System |
| DOC CON | - | Document Control Department at CUBIC |
| DocCon | - | Document Control System |
| DSL | - | Digital Subscriber Loop |
| ERD | - | Entity Relationship Diagram |
| ERWIN | - | Entity Relationship Windows |
| FPS | - | Frame Per-Second |
| GB | - | Gigabyte |
| GHz | - | Gigahertz |

| | | |
|--------|---|---|
| GIF | - | Graphic Interchange Format |
| HAS | - | Human Audio System |
| HOD | - | Head of Department (CUBIC) |
| HOS | - | Head of Supervisor (CUBIC) |
| HTML | - | Hypertext Markup Language |
| HTML | - | Hypertext Markup Language |
| HTTP | - | Hypertext Transfer Protocol |
| HVS | - | Human Visual System |
| IE 6.0 | - | Internet Explorer 6.0 |
| IE | - | Internet Explorer |
| IIS | - | Internet Information Service |
| IP | - | Internet Protocol |
| IS | - | Information System |
| ISP | - | Internet Service Provider |
| ITU-R | - | International Telecommunication Union - Radio |
| JPEG | - | Joint Photographic Expert Group |
| LAN | - | Local Area Network |
| LEDs | - | Light Emitting Diodes |
| LODF | - | Lost of Document Form (CUBIC) |
| Mb | - | Megabyte |
| MHz | - | Megahertz |
| MyNic | - | Malaysia Network Information Centre |
| N/A | - | Not Available |
| Nm | - | Nanometer |
| NTSC | - | National Television System Committee |
| ODBC | - | Open Database Connectivity |
| ODBC | - | Open Database Connectivity |
| PDF | - | Portable Document Format |
| RAM | - | Random Access Memory |
| RGB | - | Red, Green and Blue |
| RJ45 | - | Registered Jack 45 (8 Position 8 Conductor) |

| | | |
|---------|---|--|
| ROM/RW | - | Read Only Memory/Rewritable |
| SATA | - | Serial ATA (Attachment) |
| SDI | - | Single Design Interface |
| SDK | - | System Development Kit |
| SDLC | - | System Development Life-Cycle |
| SQL | - | Structured Query Language |
| sRGB | - | Standard Red, Green and Blue |
| SSADM | - | Structured System Analysis and Design Method |
| SWOT | - | Strengths, Weaknesses, Opportunities and Threats |
| TCP | - | Transmission Control Protocol |
| TV | - | Television |
| UML | - | Unified Modeling Language |
| UTeM | - | Universiti Teknikal Malaysia Melaka |
| WIS | - | Web Information System |
| WT | - | Web Technology |
| WYSIWYG | - | What You See is What You Get |
| YUV | - | Y (Luma), UV (Chrominance) |

LIST OF SYMBOLS

| | | |
|-------------------------------|---|---|
| \copyright | - | Copyright |
| cd | - | Candela |
| lm | - | Luminance |
| Ω | - | Watermarking Scheme |
| E | - | Embedding Method |
| D | - | Detection |
| R | - | Retrieval |
| M | - | Message |
| Pe | - | Watermarking Parameter |
| Pd | - | Detection Parameter |
| Pr | - | Retrieval Parameter |
| Φ | - | Luminous Intensity |
| I | - | Radiant Intensity |
| $\bar{y}(\lambda)$ | - | Standard luminosity Function. |
| XYZ, xyY | - | Colour Spaces |
| Y | - | Relative Luminance |
| S_{EA} | - | Signal of Embedding and Attacking Function |
| $\det_D(\Omega^*, S_{EA})$ | - | Detection Function of the Robustness |
| Rob_R | - | Proposed Robustness Principle Detection |
| $Rob_R(E, S)$ | - | Proposed Robustness Detection (Embedding Method, Message) |
| $Rob_{Det}(\Omega^*, S_{EA})$ | - | Proposed Detection (Detection Function of the Robustness) |

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