

**Approaches for Copyright Protection of Compressed and
Uncompressed Video Data using Enhanced
Watermarking Techniques**

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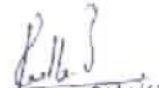
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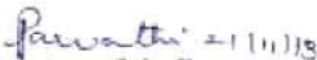
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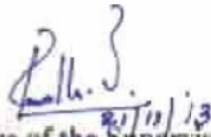


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DECLARATION

I hereby declare that the matter embodied in the thesis entitled “**Approaches for Copyright Protection of Compressed and Uncompressed Video Data using Enhanced Watermarking Techniques**” is the result of investigations carried out by me in the Department of Computer Science, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, under the supervision and guidance of **Dr.(Mrs.)V.Radha**, Professor, Department of Computer Science, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore, and it has not been submitted for the award of any Degree / Diploma / Associateship / Fellowship or similar title to any University or Institute.



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CONTENTS

CHAPTER No.	TITLE	PAGE No.
	LIST OF TABLES	x
	LIST OF FIGURES	xii
	LIST OF ABBREVIATIONS	xv
	ABSTRACT	xviii
1	INTRODUCTION	1
1.1	Overview of the Research Topic	1
1.2	Information Security	3
1.3	Digital Watermarking	8
1.4	Taxonomy of Watermarking Techniques	10
1.4.1	Types of Data Embedded	10
1.4.2	Human Perception	13
1.4.3	Extraction Method	13
1.4.4	Processing Domain	14
1.4.5	Robustness Feature	15
1.4.6	Application	15
1.5	Digital Video Watermarking	16
1.5.1	Place of Watermarking	17
1.5.2	Features of Video Watermarking	18
1.5.3	Applications of Video Watermarking	21
1.6	Attacks in Video Watermarking	23
1.7	Challenges in Video Watermarking	24
1.8	Motivation	26
1.9	Research Objectives	27
1.10	Organization of the Chapters	28
1.11	Chapter Summary	29

2	REVIEW OF LITERATURE	30
2.1	History of Digital Watermarking	30
2.2	Image Watermarking Techniques used for Video Watermarking	32
2.3	Video Watermarking Algorithms	35
2.3.1	Spatial Domain Watermarks	36
2.3.2	Frequency Domain Watermarks	41
2.3.3	MPEG-Based Watermarking Schemes	54
2.4	HVS-Based Techniques	56
2.5	Real-Time Watermarking	58
2.6	Chapter Summary	59
3	METHODOLOGY	61
3.1	Techniques to Select Embedding Frames	63
3.2	Watermarking Techniques for Uncompressed Video Domain	64
3.3	Watermarking Techniques for Compressed Video Domain	66
3.3.1	Transformation Based Approaches	66
3.3.2	Feature Point-Based Algorithm	66
3.4	Techniques Used	67
3.4.1	Discrete Cosine Transformation	67
3.4.2	Discrete Wavelet Packet Transformation	69
3.4.3	Visual Cryptography	71
3.5	MPEG Video Format	75
3.5.1	MPEG-1 Bit Stream	75
3.5.2	Types of Macroblock Present in a Frame	80
3.5.3	Motion Estimation and Compensation	83
3.6	Chapter Summary	84

4	DESIGN OF FRAME AND REGIONS SELECTION ALGORITHMS	85
4.1	Scene Detection and Video Watermarking	87
4.2	Image Sequence Generation	88
4.3	Motion Activity Frame Detection	90
4.3.1	Motion Features	90
4.3.2	Labeling Algorithm to Identify Embedding Regions(LAER)	92
4.3.3	ILMAF-UC Algorithm	94
4.3.4	ILMAF-C Algorithm	101
4.4	Chapter Summary	106
5	DESIGN OF VIDEO WATERMARKING TECHNIQUES	107
5.1	Generation of Watermark	107
5.2	Watermarking in Uncompressed Video	108
5.2.1	WGSBS Algorithm	114
5.2.2	WGDBS Algorithm	115
5.2.3	Watermark Extraction Process	123
5.3	Watermarking in Compressed Video	124
5.3.1	DCT-SVD and DWPT-SVD Algorithm	124
5.3.2	FPBA Algorithm	129
5.4	Chapter Summary	133
6	RESULTS AND DISCUSSION	134
6.1	Experimental Setup	134
6.1.1	Performance Parameters	137
6.1.2	Watermark Attacks	139
6.1.3	Coding Scheme	140

6.2	Experimental Results of Watermarking Algorithms for Uncompressed Videos	142
6.2.1	Capacity	142
6.2.2	Robustness (Security)	146
6.2.3	Imperceptibility	153
6.2.4	Complexity	153
6.3	Performance Evaluation of Watermarking Algorithms for Compressed Domain	154
6.3.1	Capacity	154
6.3.2	Robustness (Security)	155
6.3.3	Imperceptibility	165
6.3.4	Complexity	165
6.4	Visual Results	166
6.5	Chapter Summary	166
7	SUMMARY AND CONCLUSION	171
	BIBLIOGRAPHY	174
	PUBLICATIONS RELATED TO THE RESEARCH WORK	193

LIST OF TABLES

TABLE NO.	TITLE	PAGE NO.
1.1	Applications of Video Watermarking	22
2.1	Merits and Demerits of Video Watermarking	33
3.1	Function of Each Layer of the Bit Stream	76
3.2	Macroblock Types in I Frame	81
3.3	Macroblock Types in P Frame	81
3.4	Macroblock Types in B Frame	82
4.1	Motion Activity Classification	91
4.2	Arrays Used	105
6.1	Watermark Characteristics and Performance Metrics	137
6.2	Attacks Considered	140
6.3	Coding Scheme	141
6.4	PSNR (dB) of Watermarking Algorithms for Uncompressed Domain	142
6.5	Robustness (PSNR) – Uncompressed Foreman Video	147
6.6	Robustness (PSNR) – Uncompressed Mobile Video	147
6.7	Robustness (PSNR) – Uncompressed Phone Video	148
6.8	Robustness (PSNR) – Uncompressed Cactus Video	148
6.9	Robustness (PSNR) – Uncompressed News Video	149
6.10	Robustness (PSNR) – Uncompressed Coastguard Video	149
6.11	Robustness (NC) – Uncompressed Foreman Video	150

6.12	Robustness (NC) – Uncompressed Mobile Video	150
6.13	Robustness (NC) – Uncompressed Phone Video	151
6.14	Robustness (NC) – Uncompressed Cactus Video	151
6.15	Robustness (NC) – Uncompressed News Video	152
6.16	Robustness (NC) – Uncompressed Coastguard Video	152
6.17	Complexity in terms of Execution Speed (seconds) for Uncompressed Domain	153
6.18	Capacity of Watermarking Algorithms for Compressed Domain	154
6.19	Robustness (PSNR) – Compressed Foreman Video	159
6.20	Robustness (PSNR) – Compressed Mobile Video	159
6.21	Robustness (PSNR) – Compressed Phone Video	160
6.22	Robustness (PSNR) – Compressed Cactus Video	160
6.23	Robustness (PSNR) – Compressed News Video	161
6.24	Robustness (PSNR) – Compressed Coastguard Video	161
6.25	Robustness (NC) – Compressed Foreman Video	162
6.26	Robustness (NC) – Compressed Mobile Video	162
6.27	Robustness (NC) – Compressed Phone Video	163
6.28	Robustness (NC) – Compressed Cactus Video	163
6.29	Robustness (NC) – Compressed News Video	164
6.30	Robustness (NC) – Compressed Coastguard Video	164
6.31	Complexity in terms of Execution Speed (seconds) for Compressed Domain	165

LIST OF FIGURES

FIGURE NO.	TITLE	PAGE NO.
1.1	Data or Information Hiding Tools	4
1.2	Process of Cryptography	5
1.3	Process of Steganography	5
1.4	Digital Fingerprinting	7
1.5	Digital Watermarking	7
1.6	Watermark Lifecycle Phases	9
1.7	Watermarking Techniques	11
1.8	Types of Data Embedded	12
1.9	Visible and Invisible Watermarking	13
2.1	General Categories of Video Watermarking Techniques	36
3.1	Research Design	62
3.2	The Subband Stack	70
3.3	Fully Decomposed 3-level Wavelet Packet Tree	70
3.4	One Step Subband Split	71
3.5	Tree Representation of the Bases	71
3.6	Visual Cryptography Procedure	73
3.7	(2, 2) VC Scheme with 2x2 Subpixels	74
3.8	Reconstruction of Pixels	75
3.9	Layered Structure of MPEG Bit Stream	76
3.10	P Frames	78
3.11	B Frames	78
3.12	A Single Frame Divided into Slices	78
3.13	Compression	80
3.14	Structure of a Macroblock and Block Numbering Convention	80

3.15	A forward predicted motion vector	84
4.1	Steps of Proposed Frame and Region Selection Algorithm	86
4.2	Image Sequence Generation Procedure	88
4.3	Video Sequence Extracted from Foreman MPEG File (Partial)	89
4.4	Embed and Other Regions	92
4.5	Block Locations Used for MV Prediction	94
4.6	Classification of Blocks Procedure	94
4.7	Steps in ILMAF-UC Algorithm	95
4.8	Traditional ARPS Algorithm	97
4.9	Adaptive Rood Pattern: The predicted motion vector is (3,-2) and the step size $S = \text{Max}(3 , -2) = 3$	97
4.10	Search Patterns used in EARPS	99
4.11	Steps in EARPS	101
4.12	Steps in ILMAF-C Algorithm	102
4.13	Converting from Bit Stream Order to Display order	104
4.14	Procedure to Store Motion Vectors from Different Frames	105
5.1	Watermark Embedding in Irrelevant Region of Video	109
5.2	Compression Technique Removes Irrelevant Region of Video	109
5.3	Solutions to Contradiction Problem	111
5.4	Compression of Object Borders	113
5.5	Spatial Position of Window	113
5.6	WGSBS Embedding Algorithm	115
5.7	WGDBS Embedding Algorithm	116
5.8	Clustering Algorithm for Dynamic Block Creation	117
5.9	NCG Process	118
5.10	Weighting Function and Example for Geometric Warping	119

5.11	Architecture of ANN	122
5.12	Watermark Extraction Process	123
5.13	Nested Watermark Extraction Procedure	124
5.14	Illustration of SVD	126
5.15	DCT-SVD and DWPT-SVD Algorithms	127
5.16	SVD – U Component Modification Algorithm	128
5.17	Extraction Process of Transformation Based Algorithms	129
5.18	FPBA Algorithm	130
5.19	FPBA Watermark Extraction Algorithm	132
6.1	Sample Frames	136
6.2	Copyright Images	137
6.3	PSNR of Foreman (Uncompressed)	143
6.4	PSNR of Mobile (Uncompressed)	143
6.5	PSNR of Phone (Uncompressed)	144
6.6	PSNR of Cactus (Uncompressed)	144
6.7	PSNR of News (Uncompressed)	145
6.8	PSNR of Coastguard (Uncompressed)	145
6.9	PSNR of Foreman (Compressed)	156
6.10	PSNR of Mobile (Compressed)	156
6.11	PSNR of Phone (Compressed)	157
6.12	PSNR of Cactus (Compressed)	157
6.13	PSNR of News (Compressed)	158
6.14	PSNR of Coastguard (Compressed)	158
6.15	Visual Results in Uncompressed Domain	168
6.16	Visual Results in Compressed Domain	170

LIST OF ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
4SS	4 Step Search
ANN	Artificial Neural Network
ARPS	Adaptive Rood Pattern Search
CAR	Confidentiality, Availability and Reliability
CPTWG	Copy Protection Technical Working Group
DCT	Discrete Cosine Transformation
DCT-SVD	DCT-SVD Combined with Clustering Based Watermarking Algorithm
DEW	Differential Energy Watermarks
DFT	Discrete Fourier Transformation
DMB	Digital Media Broadcasting
DMV	Differential Motion Vectors
DRM	Digital Rights Management
DS	Diamond Search
DVD	Digital Video Disc
DWPT	Discrete Wavelet Packet Transformation
DWPT-SVD	DWPT-SVD Combined with Clustering Based Watermarking Algorithm
DWT	Discrete Wavelet Transformation
EARPS	Enhanced Adaptive Rood Pattern Search
ER	Embed Region
ES	Exhaustive Search
EST	Early Search Termination
FAX	Facsimile
FFT	Fast Fourier Transformation
FPBA	Feature Point Based Algorithm

GEO	Geometric
GOP	Group of Pictures
HDTV	High Definition Television
HIS	Hue Intensity Saturation
HVS	Human Visual System
ICA	Independent Component Analysis
IDCT	Inverse Discrete Cosine Transformation
IDWPT	Inverse Discrete Wavelet Packet Transformation
ILMAF-C	Identification of Low Motion Activity Frames Algorithm for compressed domain
ILMAF-UC	Identification of Low Motion Activity Frames Algorithm for Uncompressed domain
IP	Intellectual Property
IPTV	Internet Protocol Television
ISC	Initial Search Center
ISO	International Standards Organization
IT	Information Technology
JAWS	Just Another Watermarking System
JND	Just Noticeable Difference
JPEG	Joint Photographic Experts Group
LCRs	Local Circular Regions
LPF	Low Pass Filtering
LSB	Least Significant Bit
MBD	Minimum Block Distortion
M-JPEG	Moving Joint Photographic Experts Group
MPEG	Moving Picture Experts Group
MPEG-2	Moving Picture Experts Group-2
MPEG-4	Moving Picture Experts Group-4
MPEG-7	Moving Picture Experts Group-7
MSE	Mean Square Error
MTWM	Multithreshold Wavelet Method
MV	Motion Vector

NC	Normalized correlation
NTSS	New Three Step Search
OR	Other Region
PCA	Principal Component Analysis
PN	Pseudo Number
PSNR	Peak Signal to Noise Ratio
QIM	Quantized Index Modulation
RDWT	Redundant Discrete Wavelet Transformation
RGB	Red Green Blue
RMSE	Root Mean Square Error
SAD	Sum of Absolute Difference
SDMI	Secure Digital Music Initiative
SES	Simple and Effective Search
SSS	Secret Sharing Scheme
SVD	Singular Value Decomposition
TSS	Three-Step Search
URP	Unit-size RoodPattern
VC	Visual Cryptography
VLC	Variable Length Code
VOD	Video On Demand
VSSS	Visual Secret Sharing Scheme
WGDBS	Enhanced Wavelet Packet based watermarking algorithm based on Geometric Warping with HVS based criteria using neural network combined with Dynamic Block Selection Algorithm
WGSBS	Enhanced Wavelet Packet based watermarking algorithm based on Geometric Warping with HVS based criteria using neural network combined with Static Block Selection Algorithm
WPT	Wavelet Packet Transformation
WSQ	Wavelet-packet Scalar Quantization
XOR	Exclusive-OR

ABSTRACT

In the current era of communication medium, the usage of digital video has increased tremendously. In response to this increase, the importance of using property rights protection system for content protection has become a vital element of communication. Digital watermarking describes methods and technologies that hide information, which can be used as copyright control mechanism. In this research, watermarking methods, as a mechanism for content protection of video are proposed.

The copyright information is created as a nested watermark using wavelet transformation and visual cryptography. The study proposes techniques that embed the copyright data before compression (raw video data) or after compression. The MPEG video standard is used for compressed videos. Before embedding, in order to increase the robustness of the algorithms, a frame selection and region selection algorithm is used. This algorithm identifies optimal frames and regions within these frames that produce minimal distortion in the watermarked video.

Two techniques are proposed to watermark videos in uncompressed form. Both the techniques are built on wavelet packet coefficients based on geometric warping and Human Visual System. To increase the robustness geometric warping with block selection method is used. Two types of algorithms are used, namely, static and dynamic block selection during watermark embedding. The extraction of watermark consists of performing the embedding process in reverse order.

For watermarking compressed videos, three techniques are proposed. The techniques are based on Discrete Cosine Transformation, Discrete Wavelet Transformation and Feature based algorithm. The algorithms, in order to increase robustness and security use the SVD and dynamic block selection algorithms.

The research work, thus proposes a total of five algorithms, two for watermarking uncompressed videos and three for watermarking compressed videos. Several experiments were conducted to evaluate the proposed algorithms in terms of

payload, transparency, robustness and complexity using Peak Signal to Noise Ratio, Normalized Coefficients and speed of algorithms respectively. Robustness was tested using 13 attacks, namely frame averaging attack, frame dropping attack, frame swapping attack, cropping attack, rotation attack, collusion attack, impulsive noise attack, Gaussian noise attack, sharpening attack, blur attack, brighten attack, JPEG compression attack and MPEG compression attack.

Experimental results showed that all the proposed algorithms are robust and introduce minimum distortion in the watermarked domain. In particular, while considering uncompressed domain, the WGDBS (Enhanced Wavelet Packet based watermarking algorithm based on Geometric Warping with HVS based criteria using neural network combined with Dynamic Block Selection Algorithm) algorithm presents maximum efficiency in terms of capacity, transparency, imperceptibility, security and speed. With compressed domain, the DWPT-SVD watermarking algorithm performed well in terms of the selected five characteristics, namely, capacity, transparency, imperceptibility, security and complexity. Thus, from the results, it can be concluded that the WGDBS and DWPT-SVD algorithms are efficient in copyright protection and are comparable with the standard quality required for the recent applications like internet and Digital Rights Management applications.