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2015 3rd International Conference on Information and Communication Technology

The 3rd International Conference on Information and Communication Technology (ICoICT) provides an open forum for researchers, engineers, policy makers, network planners, and service providers in telecommunications. Extensive exchange of information will be provided on newly emerging systems, standards, services, and variety of applications on the area of telecommunications.



2015 3rd International Conference on Information and Communication Technology (ICoICT) took place 27-29 May 2015 in Bali, Indonesia.

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Time	Ballroom	Room 1	Room 3	Session
Wednesday, May 27				
09:30-10:30	Keynote: New infrastructure and applications developed from a cryptocurrency BITCOIN and a platform ETHEREUM			
10:50-12:00	Panel Session			
13:30-15:10	Tutorial: Making Multimedia Accessible	Parallel Session	Parallel Session	Parallel Session, Parallel Session, Parallel Session
15:30-17:30	Tutorial: A Hands-on Tutorial on Face Recognition	Parallel Session	Parallel Session	Parallel Session, Parallel Session
Thursday, May 28				
08:30-09:30	Keynote: Accesible smart ICT for daily Life			
09:50-12:10	Tutorial: How to Accelerate R&D Innovation with TRIZ	Parallel Session	Parallel Session	Parallel Session, Parallel Session, Parallel Session
11:10-12:10	Tutorial: Forensic vs. Anti-forensic in Biometric: Towards Receipt-freeness and Coercion-Resistance in biometric authentication protocols			
13:30-15:10	Demo: Attacks in Remote User Authentication Scheme Review	Parallel Session	Parallel Session	Parallel Session, Parallel Session, Parallel Session
15:30-17:10	Tutorial: Eye-tracking Analysis	Parallel Session	Parallel Session	Parallel Session, Parallel Session




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Connie, Tee	D5.2	570	<i>Preliminary Work on Rotation-Invariant Algorithms for Contactless Palm Vein Biometrics</i>
	D5.3	576	<i>A Review for Gait Recognition Across View</i>
Corici, Andreea Ancuta	A1.1	81	<i>A Solution for Provisioning Reliable M2M Infrastructures Using SDN and Device Management</i>
D  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Darlis, Denny	A2.5	158	<i>An Implementation of Digital Advertising Board Using Mini PC</i>
Darwiyanto, Eko	B2.4	180	<i>Text Data Compression for Mobile Phone Using Burrows-Wheeler Transform, Move-To-Front Code and Arithmetic Coding</i>
	C2.3	224	<i>Evaluation of Academic Website Using ISO/IEC 9126</i>
Dayawati, Retno	D2.3	203	<i>Face Image-Based Gender Recognition Using Complex-Valued Neural Network</i>
De Santo, Aniello	A2.6	625	<i>Connecting Times: Using Smart Technologies for Enhancing Ancient DownTowns Experience</i>
De Santo, Massimo	A2.6	625	<i>Connecting Times: Using Smart Technologies for Enhancing Ancient DownTowns Experience</i>
Deriche, Mohamed	D2.1	190	<i>Implementation and Evaluate the No-Reference Image Quality Assessment Based on Spatial and Spectral Entropies on the Different Image Quality Databases</i>
Dewandaru, Agung	E3.1	284	<i>Evaluation on Geospatial Information Extraction and Retrieval: Mining Thematic Maps From Web Source</i>
Dongoran, Emir	E1.2	58	<i>Analysis and Implementation of Graph Indexing for Graph Database Using GraphGrep Algorithm</i>
Dwi Atmaji, Fransiskus	B5.2	545	<i>LCC Application for Estimating Total Maintenance Crew and Optimal Age of BTS Component</i>
E  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Effendy, Veronikha	C2.2	218	<i>The Implementation User Experience Model in Applications Early Childhood Education Using Hierarchical Task Analysis Method (Case Study: Introduction Learning to Read)</i>
	E3.5	388	<i>Sentiment Analysis on Twitter Using the Combination of Lexicon-Based and Support Vector Machine for Assessing the Performance of a Television Program</i>
	A4.1	483	<i>Identifying Factors That Influence Student Failure Rate Using Exhaustive CHAID (Chi-Square Automatic Interaction Detection)</i>
Elmangoush, Asma	A1.1	81	<i>A Solution for Provisioning Reliable M2M Infrastructures Using SDN and Device Management</i>
Enriko, I Ketut	C4.3	529	<i>Designing Machine-To-Machine (M2M) System in Health-Cure Modeling for Cardiovascular Disease Patients: Initial Study</i>
Erfianto, Bayu	A1.4	97	<i>(EDsHEED) Enhanced Simplified Hybrid, Energy-Efficient, Distributed Clustering for Wireless Sensor Network</i>
F  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Fajar Sidiq, Muhammad	B4.1	416	<i>Speeding Up Mobile Delay-Tolerant-Networks Simulations with CUDA-based Event Generator</i>
Farid Firmanda, Syahril	A2.4	152	<i>Scheduler and Voice Recognition on Home Automation Control System</i>
G  A B C D E F G H I J K L M N O P R S T U V W X Y Z			


Galvani, Asdi	B2.3	174	<i>Prototype of Microcontroller-Based Odometer Reading for Early Warning in the Vehicle Lubricants Replacement</i>
Gayatri, Andini	A3.5	399	<i>A Classification of Polycystic Ovary Syndrome Based on Follicle Detection of Ultrasound Images</i>
Getta, Janusz	E3.2	290	<i>Concurrent Processing of Increments in Online Integration of Semi-structured Data</i>
Gilbert, Lester	A3.4	317	<i>Technology Enhanced Interaction Framework and Method for Accessibility in Thai Museums</i>
Gozali, Alfian	E1.2	58	<i>Analysis and Implementation of Graph Indexing for Graph Database Using GraphGrep Algorithm</i>
	E3.6	393	<i>Implementation of GRAC Algorithm (Graph Algorithm Clustering) in Graph Database Compression</i>
Gunawan, Dadang	C4.3	529	<i>Designing Machine-To-Machine (M2M) System in Health-Cure Modeling for Cardiovascular Disease Patients: Initial Study</i>
Gunawan, Djoko	B4.2	428	<i>Performance Evaluation of Hybrid Parallel Computing for WRF Model with CUDA and OpenMP</i>
H  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Hadi Putra, Panca	C4.1	517	<i>E-Business Framework for Small and Medium Enterprises: A Critical Review</i>
Hadiana, Ana	B5.5	560	<i>Web Based E-Learning System Analysis Using Kansei Engineering</i>
Hadiyoso, Sugondo	B2.2	168	<i>Arrhythmia Detection Based on ECG Signal Using Android Mobile for Athlete and Patient</i>
Hall, Wendy	C2.5	236	<i>TWINE: Supporting Assessment of Trustworthiness of Web Information Using Linked Data</i>
Hamzah, Almed	C3.3	333	<i>Reexamining Usability Dimensions: The Case of Social Media</i>
Handoko, Handoko	E3.2	290	<i>Concurrent Processing of Increments in Online Integration of Semi-structured Data</i>
Harun, Jamalludin	A3.3	311	<i>Students' Task Related Assessment: Does Knowledge Construction Process Through CSCL Learning Environment Obliging?</i>
Hashim, Suhaizal	A3.3	311	<i>Students' Task Related Assessment: Does Knowledge Construction Process Through CSCL Learning Environment Obliging?</i>
Hasibuan, Zainal	C4.1	517	<i>E-Business Framework for Small and Medium Enterprises: A Critical Review</i>
Hertiana, Sofia	B3.2	247	<i>Enabling Multipath Routing for Unicast Traffic in Ethernet Network</i>
Herutomo, Anton	A1.2	87	<i>Forest Fire Detection System Reliability Test Using Wireless Sensor Network and OpenMTC Communication Platform</i>
Heryadi, Yaya	C4.4	535	<i>American Sign Language-Based Fingerspelling Recognition Using k-Nearest Neighbors Classifier</i>
Hidayat, Syarif	A2.4	152	<i>Scheduler and Voice Recognition on Home Automation Control System</i>
Hu, Qingsheng	B3.3	253	<i>A High-Speed Gearbox Based on Phase Independent Architecture for 100G Ethernet Physical Coding Sublayer</i>
Hunaini, Fachrudin	A4.4	501	<i>Optimization of Active Steering Control on Vehicle with Steer by Wire System Using Imperialist Competitive Algorithm (ICA)</i>
I  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Imaduddin, Zaki	C5.2	610	<i>Automatic Detection and Measurement of Fetal Biometrics to Determine the Gestational Age</i>

Irawan, Indwiarti	E1.5	75	<i>Implementation of Decision Tree Using C4.5 Algorithm in Decision Making of Loan Application by Debtor (casC Study: Bank Pasar of Yogyakarta Special Region)</i>
J  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Jadied, Erwid	E3.4	383	<i>Design and Implementation of Secure Fingerprint Template Using Key Binding Scheme and Random Triangle Hashing Scheme</i>
Jarot, Sigit	A2.2	142	<i>An Efficient Implementation of Sequential Detector in Spectrum Sensing Under Correlated Observations</i>
K  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Kah Ong Michael, Goh	D5.2	570	<i>Preliminary Work on Rotation-Invariant Algorithms for Contactless Palm Vein Biometrics</i>
	D5.3	576	<i>A Review for Gait Recognition Across View</i>
Karna, Nyoman	A1.3	92	<i>Autonomous Knowledge Based System for Sensor Network</i>
Kautsarina, Kautsarina	E4.2	467	<i>Towards Data Sovereignty in Cyberspace</i>
Kinasih, Sekar	B1.2	6	<i>Comparative Study of Grammatical Evolution and Adaptive Neuro-Fuzzy Inference System on Rainfall Forecasting in Bandung</i>
Kistiantoro, Achmad Imam	B4.2	428	<i>Performance Evaluation of Hybrid Parallel Computing for WRF Model with CUDA and OpenMP</i>
Kudsy, Mahally	B4.2	428	<i>Performance Evaluation of Hybrid Parallel Computing for WRF Model with CUDA and OpenMP</i>
Kuo, Chin-Fu	C3.5	344	<i>A Perl-based SNMP Agent of Networked Embedded Devices for Smart-Living Applications</i>
Kurniati, Angelina	E4.3	473	<i>Evaluation of the Online Assessment Test Using Process Mining (Case Study: Intensive English Center)</i>
Kurniawan, Aditya	C1.4	126	<i>Information System for Depicting Relations Between Banking Customer with Risk: Study Case in Indonesia</i>
Kurniawan, Uke	A2.1	137	<i>Analysis on 900 MHz and 1800 MHz LTE Network Planning in Rural Area</i>
Kusumo, Dana	B1.1	1	<i>Structural Similarity Analysis of Business Process Model Using Selective Reduce Based on Petri Net</i>
	B3.7	360	<i>Modularizing RESTful Web Service Management with Aspect Oriented Programming</i>
Kwee, Ivo	A3.7	411	<i>A Matheuristic Algorithm for the Prize-collecting Steiner Tree Problem</i>
L  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Laksitowening, Kusuma	B5.4	554	<i>Redefining E-Learning Readiness Model</i>
Lamr, Marián	B2.1	162	<i>Increasing Effectiveness of Early Warning Through Smart ICT</i>
Li, Yunjia	A3.6	405	<i>Enhancing Synote with Quizzes, Polls and Analytics</i>
Liew, Tze Hui	D5.2	570	<i>Preliminary Work on Rotation-Invariant Algorithms for Contactless Palm Vein Biometrics</i>
Liong, The Houw	B2.5	186	<i>Dimensionality Reduction for Association Rule Mining with IST-EFP Algorithm</i>
Listia Rosa, Sri	E4.4	479	<i>RFID Middleware for Fast Clearance in Container Terminal Management System</i>
	C5.4	620	<i>Application of NFC Technology for Premise Halal Certification</i>

Liyanthi, Mellia	D5.1	565	<i>Realistic Facial Animation of Speech Synchronization for Indonesian Language</i>
Lorn Jhinn, Wee	D5.2	570	<i>Preliminary Work on Rotation-Invariant Algorithms for Contactless Palm Vein Biometrics</i>
Lu, Yung-Feng	C3.5	344	<i>A Perl-based SNMP Agent of Networked Embedded Devices for Smart-Living Applications</i>
M  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Ma, Huimin	A4.2	489	<i>Regression-based Parameter Optimization for Binary Output Systems</i>
Magedanz, Thomas	A1.1	81	<i>A Solution for Provisioning Reliable M2M Infrastructures Using SDN and Device Management</i>
Maharani, Warih	D5.1	565	<i>Realistic Facial Animation of Speech Synchronization for Indonesian Language</i>
Maulidevi, Nur	A1.3	92	<i>Autonomous Knowledge Based System for Sensor Network</i>
Md. Suhadi, Salihuddin	B1.3	11	<i>Online Learning and Socratic Method in Increasing Self-Motivation: A Literature Review</i>
Mei, Gang	D4.2	445	<i>Robust and Efficient Implementations of Angle-Based Mesh Smoothing on the GPU</i>
Mohamed, Hasnah	B1.3	11	<i>Online Learning and Socratic Method in Increasing Self-Motivation: A Literature Review</i>
	C2.1	214	<i>Emerging Project Based Learning in Flipped Classroom</i>
Mohd Zaid, Norasykin	B1.3	11	<i>Online Learning and Socratic Method in Increasing Self-Motivation: A Literature Review</i>
Montemanni, Roberto	D1.3	38	<i>Permutation Codes Via Fragmentation of Group Orbits</i>
	A3.7	411	<i>A Matheuristic Algorithm for the Prize-collecting Steiner Tree Problem</i>
Mulyana, Tatang	B1.4	17	<i>Website Design of EMS-SCADA for AC Usage on a Building</i>
	C5.3	615	<i>Monitoring and Controlling of EMS-SCADA Via SMS Gateway</i>
Munajat, Bayu	B3.7	360	<i>Modularizing RESTful Web Service Management with Aspect Oriented Programming</i>
Munir, Achmad	A2.3	148	<i>Bandwidth Improvement of Square Patch Array-based AMC Using Multiple Slots Technique</i>
	C5.1	606	<i>Thin EM Wave Absorber Composed of Octagonal Patch Array and Its Characteristic Measurement</i>
Murti, Fahri	A1.5	102	<i>Enhancing Performance of Block Diagonalization Precoding in Multi User MIMO (MU-MIMO) Downlink</i>
Mustika, I Wayan	D3.4	280	<i>Seasonal Time-Series Model Using Particle Swarm Optimization for Broadband Data Payload Prediction</i>
Mutiah, Titik	A3.5	399	<i>A Classification of Polycystic Ovary Syndrome Based on Follicle Detection of Ultrasound Images</i>
Mutiara, Giva	B2.3	174	<i>Prototype of Microcontroller-Based Odometer Reading for Early Warning in the Vehicle Lubricants Replacement</i>
N  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Napitupulu, Johannes Haposan	C3.6	511	<i>Kretschmer Complex Degree Centrality and Confidence Interval Estimation Implementation for Validating User Reports on Integrated Disaster Portal and Social Media Application</i>
Naqvi, Haidlir	B3.2	247	<i>Enabling Multipath Routing for Unicast Traffic in Ethernet Network</i>
Negara, Arjuna	D3.4	280	<i>Seasonal Time-Series Model Using Particle Swarm Optimization</i>

			<i>for Broadband Data Payload Prediction</i>
Negara, Ridha	B3.2	247	<i>Enabling Multipath Routing for Unicast Traffic in Ethernet Network</i>
Nengsih, Warnia	E4.1	462	<i>A Comparative Study on MBA and Apriori Tecnique</i>
Nhita, Fhira	B1.2	6	<i>Comparative Study of Grammatical Evolution and Adaptive Neuro-Fuzzy Inference System on Rainfall Forecasting in Bandung</i>
	A3.5	399	<i>A Classification of Polycystic Ovary Syndrome Based on Follicle Detection of Ultrasound Images</i>
Novita, Riasyah	A4.1	483	<i>Identifying Factors That Influence Student Failure Rate Using Exhaustive CHAID (Chi-Square Automatic Interaction Detection)</i>
Nugraha, Prastyawan	D2.2	197	<i>A Photo Composite Detection Based on Eye Specular Highlights Using Pixel-Based Approach</i>
Nugraha, Yudhistira	E4.2	467	<i>Towards Data Sovereignty in Cyberspace</i>
Nugroho, Bambang	A1.5	102	<i>Enhancing Performance of Block Diagonalization Precoding in Multi User MIMO (MU-MIMO) Downlink</i>
Nugroho, Hertog	D4.3	451	<i>Development of Word-Based Text Compression Algorithm for Indonesian Language Document</i>
	D5.1	565	<i>Realistic Facial Animation of Speech Synchronization for Indonesian Language</i>
Nuha, Hilal	A5.2	592	<i>Fractional Fourier Transform for Decreasing Seismic Data Lossy Compression Distortion</i>
O		A B C D E F G H I J K L M N O P R S T U V W X Y Z	
O'Hara, Kieron	C2.5	236	<i>TWINE: Supporting Assessment of Trustworthiness of Web Information Using Linked Data</i>
Octavia, Johanna	A3.1	301	<i>Participatory Design of Interactive TV User Interface for Elderly People in Indonesia</i>
Olivia, Levy	A2.3	148	<i>Bandwidth Improvement of Square Patch Array-based AMC Using Multiple Slots Technique</i>
	C5.1	606	<i>Thin EM Wave Absorber Composed of Octagonal Patch Array and Its Characteristic Measurement</i>
P		A B C D E F G H I J K L M N O P R S T U V W X Y Z	
Palupi, Irma	A5.5	505	<i>Using Least-Square Monte Carlo Simulation to Price American Multi Underlying Stock Options</i>
	A5.4	602	<i>Pricing Bermudan Option Via Evolutionary Discrete Morse Flow Approach</i>
Pandapotan, Immanuel	C3.1	323	<i>Indonesian Music Fans Group Identification Using Social Network Analysis in Kaskus Forum</i>
Parsons, David	E1.3	64	<i>Big Data Analytics on Large-Scale Socio-technical Software Engineering Archive</i>
Paryasto, Marisa	C3.1	323	<i>Indonesian Music Fans Group Identification Using Social Network Analysis in Kaskus Forum</i>
Pattanaphanchai, Jarutas	C2.5	236	<i>TWINE: Supporting Assessment of Trustworthiness of Web Information Using Linked Data</i>
Peng, Bo	D4.2	445	<i>Robust and Efficient Implementations of Angle-Based Mesh Smoothing on the GPU</i>
Peranginangin, Yahya	C2.4	230	<i>Social Engagement Analysis in Online Conversation of Indonesia Higher Education Case Study: Telkom University</i>
	C3.2	328	<i>Network Market Analysis Using Large Scale Social Network</i>

			<i>Conversation of Indonesia's Fast Food Industry</i>
Permadi, Didit	A2.5	158	<i>An Implementation of Digital Advertising Board Using Mini PC</i>
Picariello, Antonio	A2.6	625	<i>Connecting Times: Using Smart Technologies for Enhancing Ancient DownTowns Experience</i>
Pinem, Asry Faidhul	D3.2	268	<i>Implementation of Classification and Regression Tree (CART) and Fuzzy Logic for Intrusion Detection System</i>
Prabowo, Sidik	A1.2	87	<i>Forest Fire Detection System Reliability Test Using Wireless Sensor Network and OpenMTC Communication Platform</i>
	A1.4	97	<i>(EDsHEED) Enhanced Simplified Hybrid, Energy-Efficient, Distributed Clustering for Wireless Sensor Network</i>
Prasetya, Wira	C1.1	108	<i>Exploring the Roles of Personality Factors on Knowledge Management System Acceptance</i>
Pratama, Heru	B2.4	180	<i>Text Data Compression for Mobile Phone Using Burrows-Wheeler Transform, Move-To-Front Code and Arithmetic Coding</i>
Prathiwi, Dwi	B1.5	23	<i>Watermarking Scheme for Authenticity and Integrity Control of Digital Medical Image Using Reed-Muller Codes and Hash Block Chaining</i>
Pratiwi MS, Putri	C3.4	338	<i>Conceptual Model of Citizen's Intention Associated to E-Government and Internet Behavior Why Do Bandung Citizens Follow the Mayor's Social Media?</i>
Pudjiastuti, Rina	A1.5	102	<i>Enhancing Performance of Block Diagonalization Precoding in Multi User MIMO (MU-MIMO) Downlink</i>
Pudjoatmodjo, Bambang	E1.4	69	<i>An Overview and Implementation of Extraction-Transformation-Loading (ETL) Process in Data Warehouse (Case Study: Department of Agriculture)</i>
Pudjoatmojo, Bambang	D2.2	197	<i>A Photo Composite Detection Based on Eye Specular Highlights Using Pixel-Based Approach</i>
Purnama, Bedy	A3.5	399	<i>A Classification of Polycystic Ovary Syndrome Based on Follicle Detection of Ultrasound Images</i>
Purnamasari, Rita	B5.3	550	<i>Design and Implementation of Regulatory Systems of Light, Temperature and Humidity Indoor Gardens Using Microcontroller</i>
Puspitasari, Shinta	C1.2	114	<i>Preliminary Study for Determining BYOD Implementation Framework Based on Organizational Culture Analysis Enhanced by Cloud Management Control</i>
Pythaloka, Dyah	D2.5	439	<i>Artificial Fish Swarm Algorithm for Job Shop Scheduling Problem</i>
R		A B C D E F G H I J K L M N O P R S T U V W X Y Z	
Rachmat, Haris	B1.4	17	<i>Website Design of EMS-SCADA for AC Usage on a Building</i>
Rakhmatsyah, Andrian	B2.3	174	<i>Prototype of Microcontroller-Based Odometer Reading for Early Warning in the Vehicle Lubricants Replacement</i>
	A3.2	305	<i>Application of M2M to Detect the Air Pollution</i>
Ramadhani, Kurniawan	D3.5	366	<i>Mobile OCR Using Centroid to Boundary and Backpropagation Neural Network</i>
Rendra, Meldi	C4.2	523	<i>The National Budget Transparency Initiative At Ministry of Finance in Open Government Data</i>
Ridwan, Ari	B5.1	539	<i>Designing an Integrated Core Banking System for A Medium-Scale Sharia Bank in Indonesia</i>
Ridwan, Ridwan	B4.2	428	<i>Performance Evaluation of Hybrid Parallel Computing for WRF Model with CUDA and OpenMP</i>
Rinandhi, Avian	C2.2	218	<i>The Implementation User Experience Model in Applications Early Childhood Education Using Hierarchical Task Analysis Method (Case Study: Introduction Learning to Read)</i>

Rismawan, Wahyu	D1.4	44	<i>Differential Evolution for the Cryptanalysis of Transposition Cipher</i>
Riza, Tengku	A2.5	158	<i>An Implementation of Digital Advertising Board Using Mini PC</i>
Rizal, Achmad	B2.2	168	<i>Arrhythmia Detection Based on ECG Signal Using Android Mobile for Athlete and Patient</i>
Robandi, Imam	A4.4	501	<i>Optimization of Active Steering Control on Vehicle with Steer by Wire System Using Imperialist Competitive Algorithm (ICA)</i>
Rochimah, Siti	E3.3	296	<i>Source Code Retrieval on StackOverflow Using LDA</i>
Rochmani, Martiana	C2.3	224	<i>Evaluation of Academic Website Using ISO/IEC 9126</i>
Rosyidi, Lukman	B3.4	257	<i>Performance Evaluation of Adaptive Network Tree Construction Mechanism for ZigBee Grid Router Network</i>
Ruan, Weihua	B3.3	253	<i>A High-Speed Gearbox Based on Phase Independent Architecture for 100G Ethernet Physical Coding Sublayer</i>
Rusdinar, Angga	B5.3	550	<i>Design and Implementation of Regulatory Systems of Light, Temperature and Humidity Indoor Gardens Using Microcontroller</i>
S  A B C D E F G H I J K L M N O P R S T U V W X Y Z			
Sa'adah, Siti	D1.4	44	<i>Differential Evolution for the Cryptanalysis of Transposition Cipher</i>
	D1.5	48	<i>Vomma:Android Application Launcher Using Voice Command</i>
	D3.1	263	<i>Speaker Recognition Implementation for Authentication Using Filtered MFCC – VQ and a Thresholding Method</i>
	D3.7	377	<i>Design and Implementation of Voice Command Using MFCC and HMMs Method</i>
Sabariah, Mira	C2.2	218	<i>The Implementation User Experience Model in Applications Early Childhood Education Using Hierarchical Task Analysis Method (Case Study: Introduction Learning to Read)</i>
	E3.5	388	<i>Sentiment Analysis on Twitter Using the Combination of Lexicon-Based and Support Vector Machine for Assessing the Performance of a Television Program</i>
	A4.1	483	<i>Identifying Factors That Influence Student Failure Rate Using Exhaustive CHAID (Chi-Square Automatic Interaction Detection)</i>
Sadewa, Reza Aulia	D3.1	263	<i>Speaker Recognition Implementation for Authentication Using Filtered MFCC – VQ and a Thresholding Method</i>
Saedudin, Rd. Rohmat	B5.2	545	<i>LCC Application for Estimating Total Maintenance Crew and Optimal Age of BTS Component</i>
Saepudin, Deni	A5.3	596	<i>Analysis and Implementation of Tracking Efficient Method to LQ45 Stock Index Portfolio Optimization</i>
Sandhyaduhita, Puspa Indahati	C1.1	108	<i>Exploring the Roles of Personality Factors on Knowledge Management System Acceptance</i>
Sanmugam, Mageswaran	B1.3	11	<i>Online Learning and Socratic Method in Increasing Self-Motivation: A Literature Review</i>
Saragih, Ariando	B5.3	550	<i>Design and Implementation of Regulatory Systems of Light, Temperature and Humidity Indoor Gardens Using Microcontroller</i>
Sari, Riri	B3.4	257	<i>Performance Evaluation of Adaptive Network Tree Construction Mechanism for ZigBee Grid Router Network</i>
Sastrosubroto, Ashwin	E4.2	467	<i>Towards Data Sovereignty in Cyberspace</i>
Satrya, Gandeva	B3.1	242	<i>The Detection of DDOS Flooding Attack Using Hybrid Analysis in IPv6 Networks</i>

Satwika, I	C5.2	610	<i>Automatic Detection and Measurement of Fetal Biometrics to Determine the Gestational Age</i>
Selviandro, Nungki	C1.2	114	<i>Preliminary Study for Determining BYOD Implementation Framework Based on Organizational Culture Analysis Enhanced by Cloud Management Control</i>
Septiana, Gia	D1.4	44	<i>Differential Evolution for the Cryptanalysis of Transposition Cipher</i>
	B2.4	180	<i>Text Data Compression for Mobile Phone Using Burrows-Wheeler Transform, Move-To-Front Code and Arithmetic Coding</i>
Setiawan, Erwin	D3.2	268	<i>Implementation of Classification and Regression Tree (CART) and Fuzzy Logic for Intrusion Detection System</i>
Setiawati, Cut Irna	C3.4	338	<i>Conceptual Model of Citizen's Intention Associated to E-Government and Internet Behavior Why Do Bandung Citizens Follow the Mayor's Social Media?</i>
Setiawati, Eni	D3.6	371	<i>Particle Swarm Optimization on Follicles Segmentation to Support PCOS Detection</i>
Shamsuddin, Siti Maryam	E4.4	479	<i>RFID Middleware for Fast Clearance in Container Terminal Management System</i>
	C5.4	620	<i>Application of NFC Technology for Premise Halal Certification</i>
Shaufiah, Shaufiah	B2.5	186	<i>Dimensionality Reduction for Association Rule Mining with IST-EFP Algorithm</i>
Shihab, Muhammad Rifki	C1.1	108	<i>Exploring the Roles of Personality Factors on Knowledge Management System Acceptance</i>
Shrestha, Ranjan	A1.1	81	<i>A Solution for Provisioning Reliable M2M Infrastructures Using SDN and Device Management</i>
Sibaroni, Yuliant	E1.5	75	<i>Implementation of Decision Tree Using C4.5 Algorithm in Decision Making of Loan Application by Debtor (casC Study: Bank Pasar of Yogyakarta Special Region)</i>
Sidiq, Muslim	D1.5	48	<i>Vomma:Android Application Launcher Using Voice Command</i>
	D3.7	377	<i>Design and Implementation of Voice Command Using MFCC and HMMs Method</i>
Sinaga, Ardiles	D4.3	451	<i>Development of Word-Based Text Compression Algorithm for Indonesian Language Document</i>
Siswanto, Bobby	B2.5	186	<i>Dimensionality Reduction for Association Rule Mining with IST-EFP Algorithm</i>
Sitorus, Indra	A5.5	505	<i>Using Least-Square Monte Carlo Simulation to Price American Multi Underlying Stock Options</i>
Skrbek, Jan	B2.1	162	<i>Increasing Effectiveness of Early Warning Through Smart ICT</i>
Smith, Derek	D1.3	38	<i>Permutation Codes Via Fragmentation of Group Orbits</i>
Sthevanie, Febryanti	D3.5	366	<i>Mobile OCR Using Centroid to Boundary and Backpropagation Neural Network</i>
Sudiharto, Dodi Wisaksono	B4.4	422	<i>Comparative Analysis of Voice Over Internet Protocol (VoIP) Quality on Priority Queue (PQ) and Class-Based Queue (CBQ) Management System Using Link-Sharing Mechanism Setting</i>
	C3.6	511	<i>Kretschmer Complex Degree Centrality and Confidence Interval Estimation Implementation for Validating User Reports on Integrated Disaster Portal and Social Media Application</i>
Suhendar, Restu	D5.4	580	<i>Scattered Object Recognition Using Hu Moment Invariant and Backpropagation Neural Network</i>
Sulistiyo, Mahmud	D2.3	203	<i>Face Image-Based Gender Recognition Using Complex-Valued Neural Network</i>
	D2.5	439	<i>Artificial Fish Swarm Algorithm for Job Shop Scheduling</i>

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Suratman, Fiky	A2.2	142	<i>An Efficient Implementation of Sequential Detector in Spectrum Sensing Under Correlated Observations</i>
Suryabrata, Andri	B5.2	545	<i>LCC Application for Estimating Total Maintenance Crew and Optimal Age of BTS Component</i>
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Suwastika, Novian	A1.2	87	<i>Forest Fire Detection System Reliability Test Using Wireless Sensor Network and OpenMTC Communication Platform</i>
	A5.2	592	<i>Fractional Fourier Transform for Decreasing Seismic Data Lossy Compression Distortion</i>
Suwawi, Dawam Dwi Jatmiko	C2.3	224	<i>Evaluation of Academic Website Using ISO/IEC 9126</i>
Syukriilah, Niila	B1.1	1	<i>Structural Similarity Analysis of Business Process Model Using Selective Reduce Based on Petri Net</i>
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	A5.1	586	<i>Modeling and Numerical Simulation of Solar Cooker with PCM as Thermal Energy Storage</i>
Tawakal, Hilmy	C5.2	610	<i>Automatic Detection and Measurement of Fetal Biometrics to Determine the Gestational Age</i>
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Tiara, Tiara	E3.5	388	<i>Sentiment Analysis on Twitter Using the Combination of Lexicon-Based and Support Vector Machine for Assessing the Performance of a Television Program</i>
Trisnowianti, Ayunda	A5.3	596	<i>Analysis and Implementation of Tracking Efficient Method to LQ45 Stock Index Portfolio Optimization</i>
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Vasanthapriyan, Shanmuganthan	D1.2	33	<i>Spider-Web Topology: A Novel Topology for Parallel and Distributed Computing</i>
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Wibowo, Agung	D2.5	439	<i>Artificial Fish Swarm Algorithm for Job Shop Scheduling Problem</i>
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Wirasasmita, Tata Soemitra	C3.6	511	<i>Kretschmer Complex Degree Centrality and Confidence Interval Estimation Implementation for Validating User Reports on Integrated Disaster Portal and Social Media Application</i>
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X			A B C D E F G H I J K L M N O P R S T U V W X Y Z
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Y			A B C D E F G H I J K L M N O P R S T U V W X Y Z
Yang, Feng	B3.5	350	<i>The Tale of Deep Packet Inspection in China: Mind the Gap</i>
Yogapratama, Ari	A2.1	137	<i>Analysis on 900 MHz and 1800 MHz LTE Network Planning in Rural Area</i>

Yulianto, Fazmah Arif	B3.1	242	<i>The Detection of DDOS Flooding Attack Using Hybrid Analysis in IPv6 Networks</i>
	B4.4	422	<i>Comparative Analysis of Voice Over Internet Protocol (VoIP) Quality on Priority Queue (PQ) and Class-Based Queue (CBQ) Management System Using Link-Sharing Mechanism Setting</i>
	B4.3	433	<i>Analysis of Liveline Addition as the New Time Constraint and the Earliest Deadline Earliest Liveline First (EDELFF) Algorithm in Real Time System</i>
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Watermarking Scheme for Authenticity and Integrity Control of Digital Medical Image using Reed-Muller Codes and Hash Block Chaining

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Abstract—Watermarking scheme can be a solution to embed more than one type of watermark that has a different purpose. Signature watermark can be used to embed some ownership information that is resistant to attack (authenticity control). Meanwhile, reference watermark can be used to detect modifications on digital medical images (integrity control). In this paper, signature watermark is embedded in frequency domain (Integer Wavelet Transform). To increase the robustness, Reed-Muller Codes can be applied in order to detect and improve if there is any modification attack. Authenticity control in this system is using Hash Block Chaining with the function of hash MD5. Based on the testing results, the combination of Reed-Muller on embedding process can improve the robustness of signature watermark from attack. Moreover, the fragility of reference watermark can be used to detect any attack of gaussian noise, sharpening, blurring, and JPEG compression. It means the proposed scheme has a good performance for authenticity and integrity control of digital medical images.

Keywords—watermarking; Reed-Muller; Spread Spectrum; HBC

I. INTRODUCTION

Nowadays, data are represented in digital form, including medical images. This phenomenon will lead to a condition that medical images have high mobility, through either the Internet or exchange data between gadgets [1]. Medical image is an image that represents part of human body, which produced through medical technology to be used in specific purposes, such as diagnosis purpose. There are some protection demands against digital medical images, such as [10]: (1) Origin authentication, represents authentication of image ownership. A medical image should be identified correctly, so the ownership of information should be kept well, means it has to be robust to any kind of image modification. (2) Integrity Control, represents checking the authentication of an image; whether a medical image has been modified or not. It is required an information related image integrity and must be vulnerable to possible modification in image distribution process.

The technique of data embedding is required to protect the image ownership. Since the technique should resistant to any attack, signature watermark can be used to solve it. Meanwhile, to detect any modification to the image, a technique of data embedding which is vulnerable to attack is

required. Reference watermark can be used to solve it. Multiple watermarking can be a solution to embed more than one type of watermark with different characteristics.

In this paper, the embedding of signature watermark in frequency domain will use Integer Wavelet Transform [7,8]. The technique to embed signature watermark will use spread spectrum. Spread spectrum has superiority especially in information embedding to the sensitive data like medical images [6]. The robustness of signature watermark is increased by Reed-Muller Codes if there is any modification in the image. Meanwhile, the technique to embed reference watermark is using Hash Block Chaining with the function of hash MD5 [9]. Some tests will be conducted to find out robustness and vulnerability of watermark embedding result using objective assessment parameter, namely PSNR (Peak Signal-to-Noise Ratio) and BER (Bit Error Rate).

II. THE MULTIPLE WATERMARKING EMBEDDING PROCESS

The process of *multiple watermark* embedding is started by selecting images which will be the host or media to embed the *watermark*, then it separated into ROI and RONI parts [2,5].

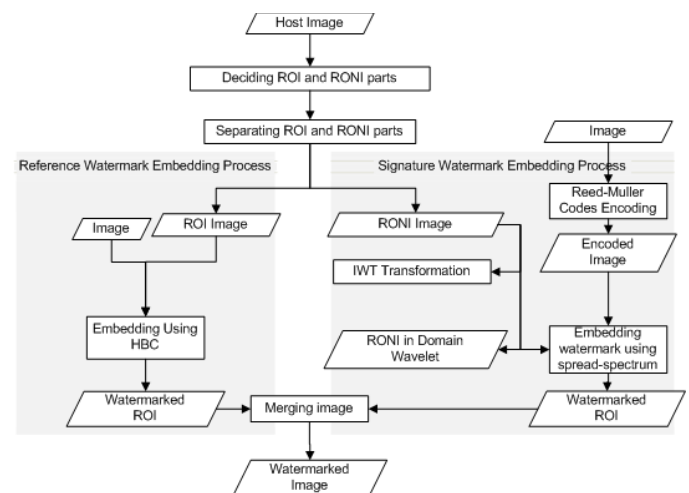


Figure 1. Watermark Embedding Process

A. Watermark Embedding

In RONI area, it is embedded to the frequency domain. While in the area of ROI image, it is embedded to spatial domain. Before embedding the *signature watermark*, firstly, it is conduct the *encoding process* using RM(1,3) [4].

1) Encoding Watermark using RM(1,3)

The process of encoding signature watermark using RM(1,3) as follows. Making generator matrix of $G_{RM(r,m)}$ using equations (1) and (2) that used recursively.

$$RM(0,m) = \{00 \dots 0, 11 \dots 1\}, RM(m,m) = K^{2^m} \quad (1)$$

$$RM(r,m) = \{(x, x+y) | x \in RM(r, m-1), y \in RM(r-1, m-1) | 0 < r < m\} \quad (2)$$

Encoding the message using equation (3).

$$c = m * G_{RM(r,m)} \quad (3)$$

where:

c = message which has been *encoded*

m = message which has been not *encoded* yet

$G_{RM(r,m)}$ = generator matrix

2) Embedding Signature Watermark

The embedding process of signature watermark to the medical images is conducted in domain frequency namely IWT. The RONI Image of I host is transformed by using IWT so it is formed the sub-bands of LL, LH, HL, and HH.

3) Embedding Reference Watermark

The steps in *reference watermark* embedding proces as follows. Divide host ROI image with $M \times N$ size into n Z_t block, where $0 < t < n$, each one has size of 8×16 pixels. Each of Z_t block will be embedded separately. Replicate the A reference watermark image which has the similar size with Host image of ROI. Divide A image which is now the size is $M \times N$ into n block of A_t , where $0 < t < n$. Set the LSB bit into Z_t to be 0. Block Z_t with LSB value 0 is block Z_t^* . Hash function which is used in proposed scheme is MD5.

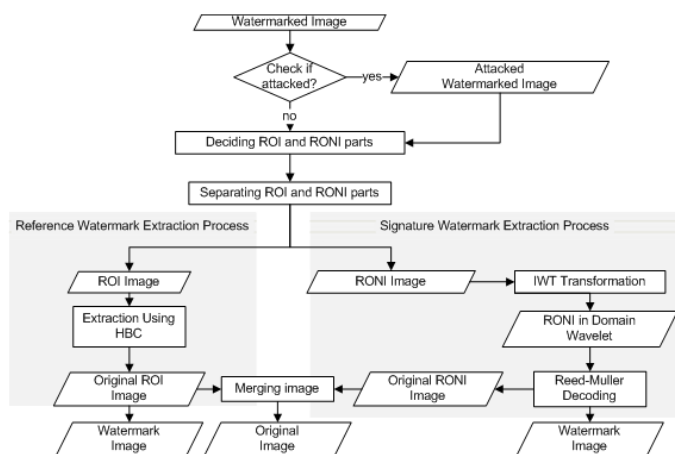


Figure 2. Watermark Extraction Process

III. THE MULTIPLE WATERMARKING EXTRACTION PROCESS

The extraction process of *multiple watermark* is not rather different with its embedding process, but the steps are done in reserve. The first step is similar to the embedding that is the

separation of RONI and ROI areas. After the extraction process, it is required *decoding process* to the *signature watermark* using RM(1,3) to return the watermark image to the former condition.

1) Extracting Reference Watermark:

The steps in extracting reference watermark are follows. Divide the image ROI with watermark with the size of $M \times N$ into n of block X_t , where $0 < t < n$, each size is 8×16 pixels. Extract the LSB value in X_t block into D_t variable. Set the LSB bit into X_t to be 0. Block X_t with LSB value 0 is block X_t^* . Do the MD5 hash function calculation. Finally, do the XOR Operation.

2) Extracting Signature Watermark

Process of embedding signature watermark as follows. RONI Image with I_w watermark is transformed into frequency domain by using IWT so it is formed the sub-bands of LL, LH, HL, and HH. Next, Generate the random number of R by using key. The matrix of R random number has similar size to the watermark image, that is $M \times N$, where the value is between 0 until 1 and has $N(0,1)$ distribution. Finally, calculate the correlation value and determine the watermark bit value from correlation value.

3) Encoding Watermark using RM(1,3)

After the extraction, then it is done the *decoding process* to the *signature watermark* to get the origin image. The steps of *decoding process* by using RM(1,3) with *majority logic* technique. The *majority logic* technique of the algorithm as follows. Next, the process in step *a* and *b* below to each row in the generator matrix, from the lowest row to upwards.

a) Select row in generator matrix of $G_{RM(1,3)}$. Find 2^{m-r} of characteristic vector for the row and do the dot product in each row by the encoded message.

$$G_{RM(1,3)} = \begin{bmatrix} \psi(1) \\ \psi(x_1) \\ \psi(x_2) \\ \psi(x_3) \end{bmatrix} = \begin{bmatrix} 11111111 \\ 11110000 \\ 11001100 \\ 10101010 \end{bmatrix} \quad \begin{matrix} \bar{x}_1 = 00001111 \\ \bar{x}_2 = 00110011 \\ \bar{x}_3 = 01010101 \end{matrix}$$

To find the characteristic vector in each row, follow the steps as follows.

- Determine the r monomial associated to the row in generator matrix.
- Determine the E which is the set of all x_i which are not in the r monomial, but are in the generator matrix. For example E if its r monomial of x_3 is $\{x_1, x_2, \bar{x}_1, \bar{x}_2\}$.
- The characteristic vector is the vector related to the combination x_i and \bar{x}_i . For example, the combination from $\{x_1, x_2, \bar{x}_1, \bar{x}_2\}$ will result characteristic vector as $\{x_1 x_2, x_1 \bar{x}_2, \bar{x}_1 x_2, \bar{x}_1 \bar{x}_2\}$. After that, do the dot product between characteristic vector and message.

b) Determine the coefficient value for selected row taken from the result majority value from dot product. For example for the row of $\psi(x_3)$, the coefficient value is 1 because 1 is the value of majority from the dot product result between characteristic vector with the message.

- c) After repeating step 1 and 2 for each row except the first row, do the steps as follows. Do the multiplication between coefficients and its corresponding row. Sum the vectors resulted from the multiplication to build M_3 . Add M_y with the accepted codeword. Determine the coefficient value for 1st row, it is taken from the summation above. If the number of 1 digit is bigger than 0 digit, so the coefficient is 1. If it is in contrast, so the coefficient is 0. Add the highest row which has been multiplied by its coefficient with M_y to get the original codeword. Arrange all coefficient in each row, start from the highest row until the lowest row to get the original message.

IV. TESTING RESULTS

A. Analysis of IWT Utilization

Based on the Fig. 3, it is showed that in LL and LH *sub-band*, the IWT performance is a little bit better than DWT, but in HL and HH sub-band, it is in contrast. But there is less different PSNR value of image with watermark between the ones using IWT and DWT. This is due to even the transformation process is different, the coefficient value of IWT and DWT transformation results are not much different.

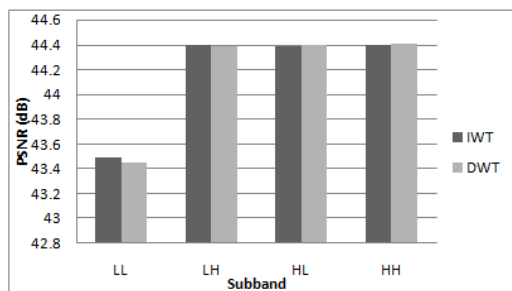


Figure 3. The comparison of IWT and DWT to the PSNR

Meanwhile, if compared in a whole, LH, HL and HH subbands have better quality if compared to LL. This is due to the LL sub-band has highest energy compared to other three subbands. So, if LL sub-band is modified, the quality will decrease.

The average embedding time of IWT is longer than DWT. This is due to the transformation process of RONI image into frequency domain in IWT, is through 3 steps after *filtering*, namely *Split*, *Predict* and *Update* step. While, if using DWT, the process done after filtering is *downsampling* with scale factor 2. Because the step with IWT is more if compared to DWT so, logically, if the watermark embedding time using IWT needs longer time if compared to DWT.

B. Analysis of Spread-Spectrum

Based on Fig. 4, it can be seen that the *spread spectrum* technique can improve the quality of image with watermark. The spread spectrum can improve the PSNR value of image with watermark up to 1,6 dB in each sub-band due to its characteristic. In spread spectrum, watermark is placed in many frequency locations so the energy in each location will be less, even can not be detected. Furthermore, the use of

random number matrix having $N(0,1)$ distribution can improve the robustness of *signature watermark* [6].

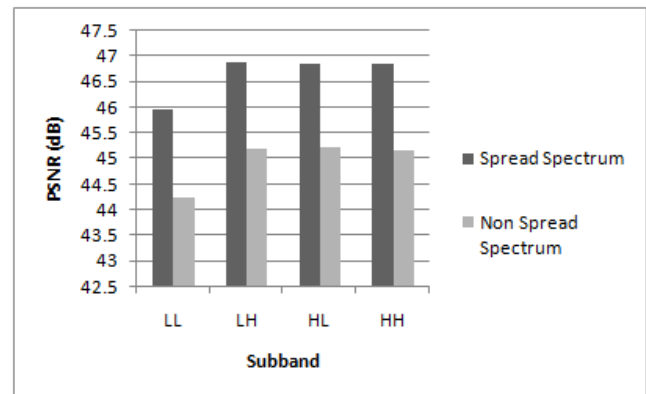


Figure 4. The comparison of Spread Spectrum and Non-SS to PSNR

In Fig. 5, it is seen that the average value of PSNR of image extraction result using *spread spectrum* is bigger than ones which are not using *spread spectrum*. As shown in figure 6, the use of watermark spread spectrum is spread in many frequency locations so the energy in each location is smaller, even it is not detected, so it will improve the robustness of *signature watermark*.

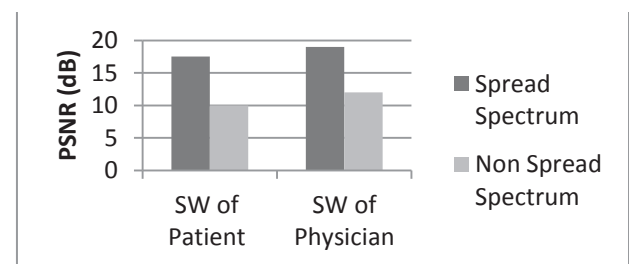


Figure 5. The effects of Spread Spectrum to the PSNR value of signature watermark image

C. Analysis of Embedding Scale Factor

In Fig. 6, it can be seen that a higher alpha level will lead to a quality of image with watermark is getting to decrease.

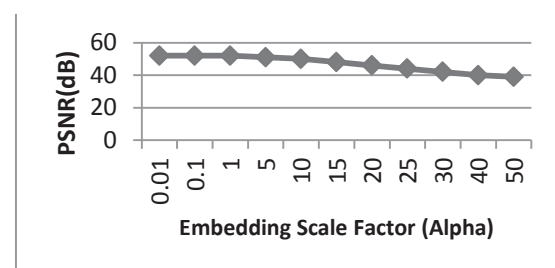


Figure 6. The alpha level effect to the quality of image with watermark

This can be seen from the PSNR decrease by the increase of alpha level. This shows that the higher alpha level, so the origin image pixel will get higher modification, resulting the decrease quality of the image. But, the contrary happens to the image of extraction result. The higher level of alpha makes watermark be increasingly robust. This is due to the alpha value shows the embedding scale strength. The bigger alpha

value, so the embedding strength of *signature watermark* will be stronger so it results to the more robustness *signature watermark*.

D. Analysis of Reed-Muller Codes Utilization

The use of Reed-Muller increases the number of bit which will be embedded, depending on its parameter. This is because of the effects to the *encoding* process, where in RM(1,3) will add the number of bit in every 4 bits to be 8 bits of codeword. It is similar to RM (1,4) that will be add the number of bit in every 5 bit to be 16 bits of codeword.

In Fig. 7, it is seen that the PSNR value decreases with the change of parameter in *Reed-Muller Codes*, so it shows that the quality of image with watermark is getting to decrease.

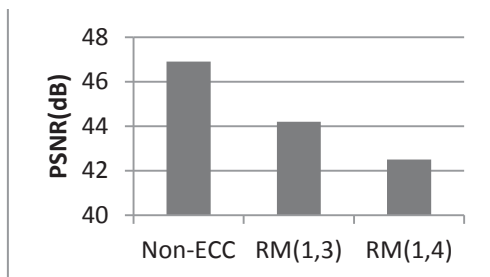


Figure 7. The effects of the use of Reed-Muller to PSNR

This is due to the number of embedded bit in the image is getting bigger by the change of parameter in Reed-Muller. If the number of embedded bit is bigger, the image quality will decrease, because there are more pixels modified for images.

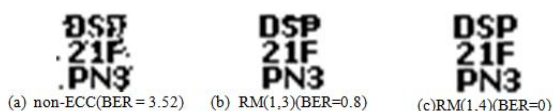


Figure 8. The extraction result of signature watermark

But, the use of Reed-Muller Codes can improve the robustness of *signature watermark*. Based on figure 7, the value of BER in watermark image which is not by the *encoding-decoding Reed-Muller* process has higher value compared to the ones using *Reed-Muller*. This is because *Reed-Muller* as an error correcting codes has an ability to correct error bits. Rm(1,3) is able to correct 1 bit error from the existence 4 bits, while RM(1,4) is able to correct 3 bits error from the exist 5 bits.

E. Impact Analysis of Block Size and Hash Function in HBC

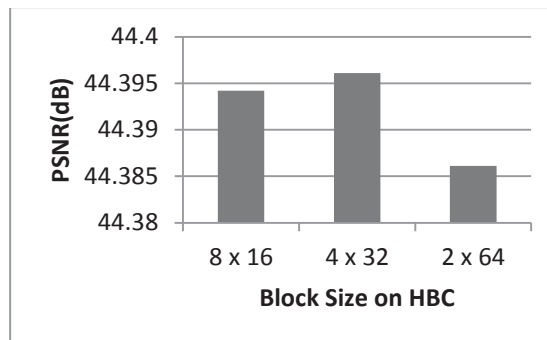


Figure 9. The effects of block size to the quality of image with watermark

Fig.9. provide the block with size of 4x32 pixels has the highest average PSNR compared to the other blocks. But, the change of PSNR value is not too significant, that is 0.01 dB. Although the block sizes are different, they all have the similar number of pixel, that is 128 pixels. The number of block is 128 pixels, because the output from the used MD5 hash function that is 128 bits is mapped to each pixel to the image.

Besides the block size, the one effecting the embedding of *reference watermark* by using HBC is the used hash function. The used hash function in this system is MD5. To know the effect of hash function at the embedding process, the used hash function is different. The used hash function in the examination are MD5, SHA-256 and SHA-512. Each hash function has different number of output bit. In MD5 output hash function results 128 bits. The SHA-256 output hash function results 256 bits. While SHA-512 output hash function results 512 bits. This will influence the used block size at embedding process. In MD5, the used block size is 8 x 16 pixels. In SHA-256, the used block size is 16x16 pixels. While, in SHA-512, the used block size is 32 x 16 pixels.

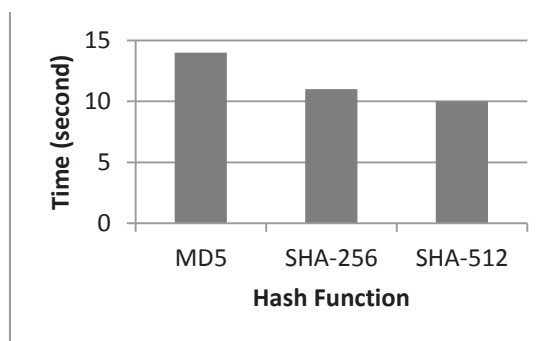


Figure 1. The hash function effects to the embedding time of reference watermark

Based on the Fig. 10, it can be seen that the MD5 hash function has the longest embedding time if compared to the two other hash functions. This is because the MD5 hash function has bigger number of block compared to the 2 other hash functions. The number of block processed by MD5 is 1152 blocks, while in SHA-256, there are only 576 blocks and in SHA-512, there are 2888 blocks.

F. The SW Robustness and RW vulnerability

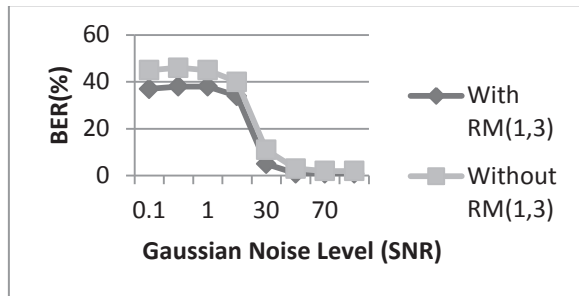


Figure 21. The effects of Reed-Muller to the attack of Gaussian Noise

The testing (Signature Watermark) robustness and RW (Reference Watermark) vulnerability is provided. Kind of attacking are gaussian noise, sharpening, blurring, and JPEG compression. In Fig. 11, it can be seen that the BER in the image of extraction result using Reed-Muller is smaller than the ones without Reed-Muller code.

This is because the Reed-Muller ability as the error correcting codes enabling to reduce the error bits while the image is attacked by Gaussian Noise. Reed-Muller has the role to improve the robustness of *signature watermark* to the attack of Gaussian Noise until reaching 4,94%.

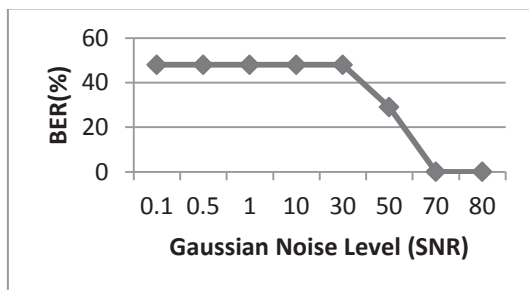


Figure 32. The effect of SNR level to the RW vulnerability

Based on Fig. 12, it is seen that the bigger SNR level given makes the smaller BER value. This is because the bigger SNR level makes the smaller noise strength given. At SNR 70 level, the BER value in *reference watermark* image has the average value that is 0, so it can be concluded that the *reference watermark* is able to detect the Gaussian Noise attack in SNR level < 70.

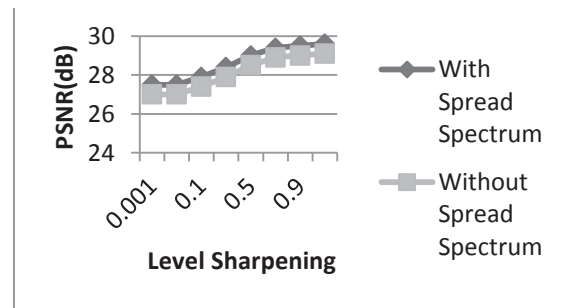


Figure 43. The effects of Spread spectrum to the sharpening attack

Based on Fig. 13, it is seen that the spread spectrum can improve the image quality with watermark until 0.5 dB constantly. This shows that the spread spectrum works well at all levels of sharpening attacks, namely from 0.001 level to 1. Also, it is seen the PSNR value increasingly bigger by the increase of sharpening level value. Even though the bigger level value of sharpening attacks, so the given attack is increasingly harder, but the image quality with watermark does not decrease. This occurs because the bigger sharpening level makes the clearer image, and meaning the more changes in the image and bigger interference with watermark bits, but the changes to the image does not significantly affect the quality of the image with watermark.

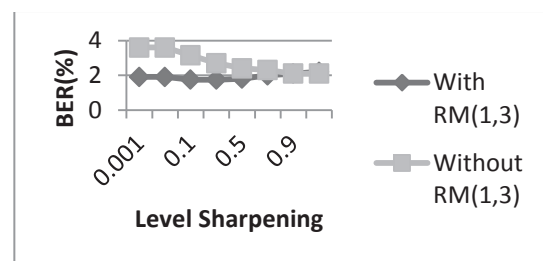


Figure 14. The effect of Reed-Muller to the Sharpening attack (BER)

While the role of Reed-Muller codes, can be seen in Fig. 14. BER value of extraction image result by using the Reed-Muller at the level of the same attack is smaller until 0.75 level than the ones which are without using the Reed-Muller. This is because the ability of Reed-Muller as error correcting codes can reduce the error bits at sharpening level of 0.001 to 0.9. But, at the attack level of > 0.9, Reed-Muller is not able to reduce the error bits. Reed-Muller has the role to improve watermark robustness against sharpening attacks up to 1.8% in the sharpening attack level < 0.9. Meanwhile, the effect of sharpening to the vulnerability of reference watermark produce a quite big BER namely, 30% to 48.1%. This shows a sharpening attack is a harsh attack.

The influence of Reed-Muller codes, it can be seen in Fig.15. At the level of 0.001 to 0.05, the given attack blur is not too strong so the average BER value is small. The average BER value to the system using RM (1,3) is smaller than the ones which are without the use of RM (1,3). This is because the Reed-Muller as error correcting codes can reduce the error bits after the images are being attacked.

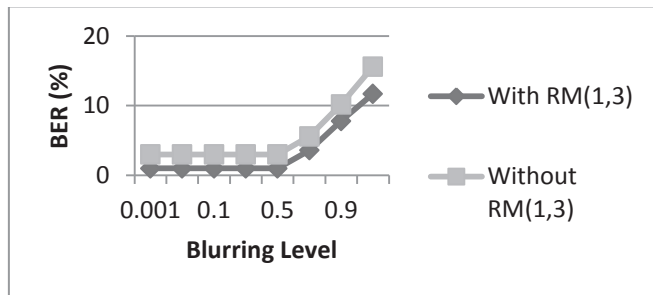


Figure 5. The effect of Reed-Muller to the Blur attack (BER)

The average BER value in the blur attack level which is above 0.5 increases by the given increase blur levels. This is due to the stronger given blur attack, but Reed-Muller is still able to reduce the BER value up to 4% in blur attack level with 1 value. The Reed-Muller has the role to improve watermark robustness against the blur attack by lowering the average BER value up to 2.07% on all levels of tested blur attack. That means that the given blur attack is very small so it is not detected by damaged reference watermark. But at the blur attack level above 0.5, attack power is high enough so it can increase the average BER value in the reference watermark. This is because the higher the blur attack level means the stronger attack which is given to the image.

Based on Fig. 16, it shows that the BER value on the extraction result image with 0.1 to 25 compression ratio is quite high until reaching the average of 18%. This shows very big compression scale factor which is increasing the number of error bits. But the strength compression decreases in compression above 25 by the addition of compression ratio. Reed-Muller can work in a small value of compression ratio so, it can lower the average BER value up to 2% in 25 of ratio value. This is because the Reed-Muller as error correcting codes can reduce the error bits after the image is attacked. Even though the performance of Reed-Muller is less optimal in the 75 ratio, but the change in BER value is not so significant so in the ratio of 90 to 99, Reed-Muller is able to reduce BER value up to 2.3%.

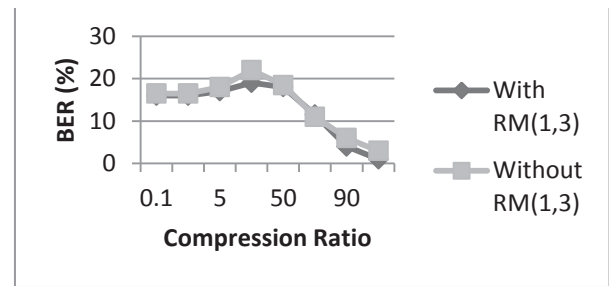


Figure 16. The effects of Reed-Muller to the JPEG compression

Meanwhile, the effect of blurring to the vulnerability of reference watermark produce a quite big BER namely, 30% to 50 %. The average BER which is high enough shows that the attack of JPEG compression is a strong enough attack resulting in severe damage to the image extraction result of reference watermark. On the other side, big enough BER value, it is can be said that the reference watermark is vulnerable to the attack of JPEG compression because in compression ratio of 99, the resulted BER value is quite high.

V. CONCLUSION

The use of Reed-Muller Codes on the embedding of signature watermark produce a robust signature watermark. Moreover, HBC on the embedding of reference watermark provide vulnerable of reference watermark to the attacks of gaussian noise, sharpening, blurring and JPEG compression. It means that the proposed scheme give a good performance for authenticity and integrity control of digital medical images.

REFERENCES

- [1] Adiwijaya, T.A.B. Wirayuda, S.D. Winanjuar, U. Muslimah, The Multiple Watermarking on Digital Medical Image for Mobility and Authenticity, Operations Research Proceedings 2012, 457-462. DOI: 10.1007/978-3-319-00795-3_68
- [2] Adiwijaya, Faoziyah, P.N., Permana, F.P., Wirayuda, T.A.B., Wisesty, U.N., Tamper detection and recovery of medical image watermarking using modified LSB and Huffman compression, Second International Conference on Informatics and Applications (ICIA), 2013, pp.129 - 132. DOI: 10.1109/ICoIA.2013.6650242
- [3] Agustina,R., Adiwijaya, and Barmawi, A.M., "Pendeteksian dan Perbaikan Citra Termanipulasi yang Disisipi Watermark Menggunakan Block Truncation Coding (BTC) Berbasis Wavelet," Jurnal PP Telekomunikasi, vol 15 No. 2, Juni 2011.
- [4] Cooke, Ben, "Reed-Muller Error Correcting Codes," MIT Undergraduate Journal of Mathematics, 1999, Vol. 1, pp. 21-26.
- [5] Kurniawan, M.T., Adiwijaya, Agung, W., Multiple watermarking on digital medical images for tamper detection and integrity control, International Conference on Uncertainty Reasoning and Knowledge Engineering, 2012, pp. 145 - 148. DOI: 10.1109/URKE.2012.6319530
- [6] Kumar, B.,Anand, A., Singh, S.P.,Mohan, A., "High Capacity Spread-Spectrum Watermarking for Telemedicine Applications," World Academy of Science, Engineering and Technology 79 2011.
- [7] Lee, Sunil,et al., "Reversible Image Watermarking Based on Integer-to-Integer Wavelet Transform". IEEE Transactions on

Information Forensics and Security Vol. 2 No. 3 September 2007.

- [8] Mostafa, S.A.K., El-sheimy,N., Tolba, A.S., Abdelkader,A.S., Elhindy,H.M., “*Wavelet Packets-Based Blind Watermarking for Medical Image Management*”. Mill The Open Biomedical Engineering Journal Vol. 4 pages 93-98 2010.
- [9] Rivest, R., “ *The MD5 Message-Digest Algorithm*”. MIT Laboratory for Computer Science and RSA Data Security, Inc
- [10] Zain, J.M, Fauzi, A.R.M., Medical Image Watermarking with Tamper Detection and Recovery, International Conference of Engineering in Medicine and Biology Society, 2006.pp. 3270 - 327