

Proceedings of

2014 6th International Conference on
Information Technology and Electrical Engineering



ICITEE 2014

2014 6th International Conference on
Information Technology and Electrical Engineering

**“Leveraging Research and Technology
through University-Industry Collaboration”**

Eastparc Hotel, Yogyakarta
7-8 October 2014



Organized by

Department of Electrical Engineering and Information Technology
Faculty of Engineering, Universitas Gadjah Mada
Jalan Grafika 2 Yogyakarta 55281, Indonesia

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Welcome Message from the General Chair

On behalf of the organizing committee, it is our pleasure to welcome you to Yogyakarta, Indonesia, for our annual conference. This is the 6th conference that is held by the Department of Electrical Engineering and Information Technology, Faculty of Engineering, Universitas Gadjah Mada. This year, the conference is differently called as Joint conference 2014 as there will be 4 parallel conferences, including:

1. ICITEE (International Conference of Information Technology and Electrical Engineering) 2014,
2. CITEE (Conference of Information Technology and Electrical Engineering) 2014,
3. RC-CIE (Regional Conference on Computer and Information Engineering) 2014, and
4. CCIO (Conference on Chief Information Officer) 2014.

The joint conference's theme is "Leveraging Research and Technology through University-Industry-Government Collaboration" emphasizes on the enhancement of research in a wide spectrum, including information technology, communication and electrical engineering, as well as e-services, e-government and information system. The conference is expected to provide excellent opportunity to meet experts, exchange information, and strengthen the collaboration among researchers, engineers, and scholars from academia, government, and industry.

In addition, the conference committee has invited five renowned keynote speakers, Prof. Marco Aiello from University of Groningen (RuG), Netherland, Prof. Einoshin Suzuki from Kyushu University, Prof. Yoshio Yamamoto from Tokai University, Prof. Jun Miura from Toyohashi University of Technology, and Prof. Kazuhiko Hamamoto from Tokai University, Japan. The conference committee also invited Tony Seno Hartono from National Technology Officer of Microsoft Indonesia and Dr. Ing. Hutomo Suryo Wasisto (Associate Team Leader in MEMS/NEMS and Sensor Group) Technische Universität Braunschweig, Germany as Invited speaker to present their current research activities.

This conference is technically co-sponsored by IEEE Indonesia Section. Furthermore, it is supported by JICA, AUN/SEED-Net, Ministry of Communication and Information Technology of The Republic of Indonesia, and King Mongkut's Institute of Technology Ladkrabang, Thailand.

As a General Chair, I would like to take this opportunity to express my deep appreciation to the organizing committee members for their hard work and contribution throughout this conference. I would also like to thank authors, reviewers, all speakers, and session chairs for their support to Joint Conference 2014.

In addition to the outstanding scientific program, we hope that you will find time to explore Yogyakarta and the surrounding areas. Yogyakarta is city with numerous cultural heritages, natural beauty, and the taste of traditional Javanese cuisines, coupled with the friendliness of its people.

Lastly, I would like to welcome you to Joint Conference 2014 and wish you all an enjoyable stay in Yogyakarta.

Sincerely,

Hanung Adi Nugroho, Ph.D.
General Chair of Joint Conference 2014

Welcome Message from the TPC Chair

On behalf of the technical program committee (TPC), we warmly welcome you to the 6th International Conference on Information Technology and Electrical Engineering (ICITEE 2014) in the cultural city of Yogyakarta, Indonesia. The committee has organized exciting technical programs for ICITEE 2014 with conference theme of "Leveraging Research and Technology through University-Industry Collaboration." As an annual International conference, ICITEE provides excellent platform to share innovative idea and experiences, exchange information, and explore collaboration among researchers, engineers, practitioners and scholars the field of information technology, communications, and electrical engineering.

All 163 submitted papers from 18 countries throughout the world went through a rigorous review process and each paper was evaluated by at least three independent reviewers in accordance with standard blind review process. Based on the results of the rigorous review process, 78 papers have been selected, which constitute the acceptance rate of 47.9%. These papers have been grouped into 5, ranging from the fields of information technology, communications, power systems, electronics, and control systems. Besides those regular sessions, ICITEE 2014 also features world-class keynote/plenary speeches and distinguish-invited speakers that reflect the current research and development trends in the aforementioned fields.

We are deeply indebted to all of our TPC members as well as our reviewers, who volunteered a considerable amount of their time and expertise to ensure a fair, rigorous, and timely review process. Many thanks should be given to our keynote and invited speakers who will share their experience in this conference. Last but not least, our sincere gratitude should be given to all authors for submitting their work to ICITEE 2014, which has allowed us to assemble a high quality technical program.

Welcome to Yogyakarta and hope you will enjoy a wonderful experience in this traditional city of Indonesia.

With best regards,

TPC Chair

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Table of Contents

Technical Sessions

➤ Session 1. Software Engineering, Services, and Information Technology

TS 1 – 01	A Hybrid Technique for Enhancement of Periductal Fibrosis Ultrasound Images for Cholangiocarcinoma Surveillance	2
	Pichet Wayalun (Khon Kaen University, Thailand); Saiyan Saiyod (Khon Kaen University, Thailand)	
TS 1 – 02	A Real Time Mission-Critical Business Intelligence for Development of Mixture Composition on Aromatherapy Product Based on Customer Personality Type	7
	Taufik Djatna (Bogor Agricultural University, Indonesia); Ida Bagus Dharma Yoga Santosa (Bogor Agriculture University, Indonesia)	
TS 1 – 03	An Infrastructure-less Occupant Context-Recognition in Energy Efficient Building	13
	Azkario Rizky (Universitas Gadjah Mada, Indonesia); Widy Widyan (Gadjah Mada University, Indonesia); Guntur Putra (Universitas Gadjah Mada, Indonesia)	
TS 1 – 04	An Integrated Model of Customer Repurchase Intention in B2C E-commerce	19
	Saowakhon Homsud (King Mongkut's Institute of Technology Ladkrabang, Thailand); Singha Chaveesuk (King Mongkut's Institute of Technology Ladkrabang, Thailand)	
TS 1 – 05	An Intuitive User Interface for Motion Retrieval on a Mobile Multi-touch Device	25
	Natta Tammachat (King Mongkut's Institute of Technology Ladkrabang, Thailand); Natapon Pantuwong (King Mongkut's Institute of Technology Ladkrabang, Thailand)	
TS 1 – 06	Automated Document Classification for News Article in Bahasa Indonesia Based on Term Frequency INVERSE Document Frequency (TF-IDF) Approach	29
	Ari Aulia Hakim (Swiss German University, Indonesia); Alva Erwin (Swiss German University, Indonesia); Kho Eng (Swiss German University, Indonesia); Maulahikmah Galinium (Swiss German University, Indonesia); Wahyu Muliady (Akon Teknologi, Indonesia)	
TS 1 – 07	Automatic Leaf Color Level Determination for Need Based Fertilizer Using Fuzzy Logic on Mobile Application	33
	Kestriilia Prilianti (Universitas Ma Chung, Indonesia)	
TS 1 – 08	Automatic Multi-Document Summarization for Indonesian Documents Using Hybrid Abstractive-Extractive Summarization Technique	39
	Glorian Yapinus (Swiss German University, Indonesia); Alva Erwin (Swiss German University, Indonesia); Maulahikmah Galinium (Swiss German University, Indonesia); Wahyu Muliady (Akon Teknologi, Indonesia)	
TS 1 – 09	Autonomous Monitoring Framework with Fallen Person Pose Estimation and Vital Sign Detection	44
	Igi Ardiyanto (Toyohashi University of Technology, Japan); Jun Miura (Toyohashi University of Technology, Japan)	
TS 1 – 10	Benchmarking of Feature Selection Techniques for Coronary Artery Disease Diagnosis	50
	Noor Akhmad Setiawan (Universitas Gadjah Mada, Indonesia); Dwi Wahyu Prabowo (Universitas Gadjah Mada, Indonesia); Hanung Adi Nugroho (Universitas Gadjah Mada, Indonesia)	
TS 1 – 11	Boosting Performance of Face Detection by Using an Efficient Skin Segmentation Algorithm	55
	Mohammad Reza Mahmoodi (Isfahan University of Technology, Iran); Sayed Masoud Sayedi (Isfahan University of Technology, Iran)	
TS 1 – 12	C2C E-Commerce Trust Level Measurement and Analysis	61
	Sayid Ali Hadi (Swiss German University, Indonesia); James Purnama (University of Indonesia, Indonesia); Moh. A. Soetomo (Swiss German University, Indonesia); Maulahikmah Galinium (Swiss German University, Indonesia)	
TS 1 – 13	Calories Analysis of Food Intake Using Image Recognition	67
	Natta Tammachat (King Mongkut's Institute of Technology Ladkrabang, Thailand); Natapon Pantuwong (King Mongkut's Institute of Technology Ladkrabang, Thailand)	
TS 1 – 14	Contrast Measurement for No-Reference Retinal Image Quality Assessment	71
	Hanung Adi Nugroho (Universitas Gadjah Mada, Indonesia); Titin Yulianti (Universitas Gadjah Mada, Indonesia); Noor Akhmad Setiawan (Universitas Gadjah Mada, Indonesia); Dhimas Arief D (Universitas Gadjah Mada, Indonesia)	
TS 1 – 15	Digital Image Hashing Using Local Histogram of Oriented Gradients	75

	Iwan Setyawan (Satya Wacana Christian University, Indonesia); Ivanna Timotius (Satya Wacana Christian University, Indonesia)	
TS 1 – 16	Emoticon-based Steganography for Securing Sensitive Data	79
	Tohari Ahmad (Institut Teknologi Sepuluh Nopember (ITS), Indonesia); Gregory Sukanto (Institut Teknologi Sepuluh Nopember (ITS), Indonesia); Hudan Studiawan (Institut Teknologi Sepuluh Nopember, Indonesia); Waskitho Wibisono (Institut Teknologi Sepuluh Nopember, Indonesia); Royyana Ijtihadie (Institut Teknologi Sepuluh Nopember (ITS), Indonesia)	
TS 1 – 17	Evaluation of Edge Orientation Histograms in Smile Detection	85
	Ivanna Timotius (Satya Wacana Christian University,Indonesia); Iwan Setyawan (Satya Wacana Christian University, Indonesia)	
TS 1 – 18	ICUMSA Identification of Granulated Sugar Using Discrete Wavelet Transform and Colour Moments	90
	Alfiah Rizky Diana Putri (Universitas Gadjah Mada, Indonesia); Adhi Susanto (Universitas Gadjah Mada, Indonesia); Litasari Litasari (Universitas Gadjah Mada, Indonesia)	
TS 1 – 19	Identification of Malignant Masses on Digital Mammogram Images	96
	Hanung Adi Nugroho (Universitas Gadjah Mada, Indonesia); Faisal N (Gadjah Mada University, Indonesia); Indah Soesanti (Universitas Gadjah Mada, Indonesia); Lina Choridah (Universitas Gadjah Mada, Indonesia)	
TS 1 – 20	Measuring Domain Decomposition Effect in Estuary Model Parallelization Using High Performance Computer	102
	Santosa Sandy Putra (UNESCO IHE - Institute for Water Education, The Netherlands)	
TS 1 – 21	Mobile Tourism Services Model: A Contextual Tourism Experience Using Mobile Services	108
	Ridi Ferdiana (Universitas Gadjah Mada, Indonesia); Bimo Sunarfri Hantono (Universitas Gadjah Mada, Indonesia)	
TS 1 – 22	Real Time Key Element Extraction for Design of In-Flight Meal Services Based on Passenger's Personality Traits	114
	Taufik Djatna (Bogor Agricultral Unlversity, Indonesia); Hety Handayani Hidayat (IPB, Indonesia)	
TS 1 – 23	Real Time Static Hand Gesture Recognition System Prototype for Indonesian Sign Language	120
	Rudy Hartanto (Universitas Gadjah Mada, Indonesia); Adhi Susanto (Universitas Gadjah Mada, Indonesia); Paulus Santosa (Gadjah Mada University, Indonesia)	
TS 1 – 24	Release of Masking and FAME Performance Evaluation to Improve Speech Intelligibility on Cochlear Implant	126
	Sena Sukmananda Suprpto (Institut Teknologi Sepuluh Nopember, Indonesia); Dhany Arifianto (Institut Teknologi Sepuluh Nopember, Indonesia); Sekartedjo Sekartedjo (Institut Teknologi Sepuluh Nopember, Indonesia)	
TS 1 – 25	Statistical Analysis of Popular Open Source Software Projects and Their Communities	132
	Andi Wahyu Rahardjo Emanuel (Universitas Kristen Maranatha, Indonesia)	
TS 1 – 26	Text-Background Decomposition for Thai Text Localization and Recognition in Natural Scenes	138
	Ungsumalee Suttapakti (King Mongkut's Institute of Technology Ladkrabang, Thailand); Kuntpong Woraratpanya (King Mongkut's Institute of Technology Ladkrabang, Thailand); Kitsuchart Pasupa (King Mongkut's Institute of Technology Ladkrabang, Thailand); Pimlak Boonchukusol (King Mongkut's Institute of Technology Ladkrabang, Thailand); Taravichet Titijaronroj (King Mongkut's Institute of Technology Ladkrabang, Thailand); Rattaphon Hokking (King Mongkut's Institute of Technology Ladkrabang, Thailand); Yoshimitsu Kuroki (Kurume National College of Technology, Japan); Yasushi Kato (Tsuruoka National College of Technology, Japan)	
TS 1 – 27	The Study of Utilization of SIP in Mobile Monitoring Abnormal Events Wireless Sensor Network	144
	Andreo Yudertha (Gadjah Mada University, Indonesia); Widy Widyawan (Gadjah Mada University, Indonesia); Sujoko Sumaryono (Gadjah Mada University, Indonesia)	
TS 1 - 28	TIS Dishub DIY: An Implementation of Traveler Information System in Special Region of Yogyakarta	150
	Daniel Febrian Sengkey (Gadjah Mada University, Indonesia); Sayuri Egaravanda (Universitas Gadjah Mada, Indonesia); Lukito Nugroho (Universitas Gadjah Mada, Indonesia)	
TS 1 – 29	Website Quality Assessment for Portal Hospital Indonesia Using Gap Analysis	156
	Muhammad Adipridhana (Swiss German University, Indonesia); Maulahikmah Galinium (Swiss German University, Indonesia); Heru Ipung (Swiss German University, Indonesia)	

➤ **Session 2. Wireless Communications, Networking and Vehicular Technology**

TS 2 – 01	3D Artificial Material Characterization Using Rectangular Waveguide	164
	Danang Wibowo (ITB, Indonesia); Achmad Munir (Institut Teknologi Bandung, Indonesia)	
TS 2 – 02	Design on FPGA of the IEEE 802.11p Standard Baseband OFDM Section Model	168

Budi Setiyanto (Universitas Gadjah Mada, Indonesia); Rani Aji (Universitas Gadjah Mada, Indonesia); Afatika Adianti (Universitas Gadjah Mada, Indonesia); Addin Suwastono (Universitas Gadjah Mada, Indonesia)

TS 2 – 03	Development of Embedded Gateway for Wireless Sensor Network and Internet Protocol Interoperability	174
	Sigit Basuki Wibowo (Gadjah Mada University, Ireland); Guntur Putra (Universitas Gadjah Mada, Indonesia); Bimo Sunarfri Hantono (Universitas Gadjah Mada, Indonesia)	
TS 2 – 04	Dynamic CFO Reduction in Various Mobilities Based on Extended Kalman Filter for Broadband Wireless Access Technology	178
	Asri Diliyanzah (Telkom University, Indonesia); Rina Pudjiastuti (Telkom University, Indonesia); Budi Syihabuddin (Telkom University, Indonesia)	
TS 2 – 05	Experimental Study on Improved Parametric Stereo for Bit Rate Scalable Audio Coding.....	184
	Ikhwana Elfitri (Andalas University, Indonesia); Rahmadi Kurnia (Andalas University, Indonesia); Defry Harneldi (Andalas University, Indonesia)	
TS 2 – 06	FDTD Method for Scattering Parameters Extraction of Rectangular Waveguide Loaded with Anisotropic Dielectric Material.....	189
	Achmad Munir (Institut Teknologi Bandung, Indonesia); Maulana Randa (Badan Penelitian Dan Pengembangan Kementerian Pertahanan RI, Indonesia)	
TS 2 – 07	FSS-based Planar Bandpass Filter Using Strip Slotted-Lines.....	194
	Eric Simbolon (Bandung Institute of Technology, Indonesia); Achmad Munir (Institut Teknologi Bandung, Indonesia)	
TS 2 – 08	High Gain RF Amplifier for Very Low Frequency Receiver Application	199
	Rahmat Putera (Institut Teknologi Bandung, Indonesia); Achmad Munir (Institut Teknologi Bandung, Indonesia)	
TS 2 – 09	Investigation on Objective Performance of Closed-loop Spatial Audio Coding	203
	Ikhwana Elfitri (Andalas University, Indonesia); Rahmadi Kurnia (Andalas University, Indonesia); Fitrilina Fitrilina (Andalas University, Indonesia)	
TS 2 – 10	Performance of Anti-Jamming Techniques with Bit Interleaving in OFDM-Based Tactical Communications	209
	Pradini Puspitaningayu (Universitas Negeri Surabaya, Indonesia); Gamantyo Hendrantoro (Sepuluh Nopember Institut of Technology, Indonesia)	
TS 2 – 11	Performance of Repeat-Accumulate Codes (RAC) for Decode-and-Forward Wireless Relay Channel	214
	Daryus Chandra (Universitas Gadjah Mada, Indonesia); Adhi Susanto (Universitas Gadjah Mada, Indonesia); Sri Suning Kusumawardani (Universitas Gadjah Mada, Indonesia)	
TS 2 – 12	Reorganizing Fingerprint Information Using Intersection Technique for RFID-based Indoor Localization System.....	220
	I Wayan Mustika (Universitas Gadjah Mada, Indonesia); Sisongkham Phimmasean (NUOL, Laos)	
TS 2 – 13	RSSI Based Analysis of Bluetooth Implementation for Intra-Car Sensor Monitoring	225
	Eka Firmansyah (UGM, Indonesia); Lafiona Grezelda (Gadjah Mada University, Indonesia); Iswandi Iswandi (Gadjah Mada University, Indonesia)	

➤ Session 3. Power Systems

TS 3 – 01	A Probabilistic Approach to Analyze and Model the Simultaneity of Power Produced by Wind Turbines in a Wind Farm	232
	Kaveh Malekian (Chemnitz University of Technology, Germany); Anne Göhlich (Chemnitz University of Technology, Germany); Liana Pop (Chemnitz University of Technology, Germany); Wolfgang Schufft (University of Technology Chemnitz, Germany)	
TS 3 – 02	An Improved Maximum Efficiency Control for Dual-Motor Drive Systems	239
	Luiz Rizki Ramelan (Universitas Gadjah Mada, Indonesia); Eka Firmansyah (UGM, Indonesia); Tian-Hua Liu (National Taiwan University of Science and Technology, Taiwan); Shao-Kai Tseng (National Taiwan University of Science and Technology, Taiwan); Jing-Wei Hsu (National Taiwan University of Science and Technology, Taiwan)	
TS 3 – 03	CCT Computation Method Based on Critical Trajectory Using Simultaneous Equations for Transient Stability Analysis.....	245
	Ardyono Priyadi (ITS, Indonesia); Ony Qudsi (Politeknik Elektronika Negeri Surabaya, Indonesia); Mauridhi Purnomo (Institut of Technology Sepuluh Nopember, Indonesia)	
TS 3 – 04	Comparison of Economic Models for Two Differently Configured Uninterrupted Power Supply Systems From User Electricity Bill Perspective.....	251
	Awais Yousaf (The University of Lahore, Pakistan); Onaiza Yousaf (The University of Lahore, Pakistan); Durdana Yousaf (Lahore Electric Supply Company, Pakistan)	

TS 3 – 05	Development of a Power Flow Software for Distribution System Analysis Based on Rectangular Voltage Using Python Software Package.....	255
	Lukmanul Hakim (Universitas Lampung, Indonesia); Muhamad Wahidi (Universitas Lampung, Indonesia); Trisno Handoko (Universitas Lampung, Indonesia); Herri Gusmedi (Universitas Lampung, Indonesia); Noer Soedjarwanto (Universitas Lampung, Indonesia); Federico Milano (University College Dublin, Ireland)	
TS 3 – 06	Efficiency Improvement of a Solar Power Plant Using Combine Cycle: An Experimental Study on a Miniaturized Solar Power Station.....	260
	Bishwajit Banik Pathik (American International University-Bangladesh, Bangladesh); Nipu Datta (American International University-Bangladesh, Bangladesh); Muhammad Najebul Ahmed (American International University-Bangladesh, Bangladesh); Rokhsana Liya (American International University-Bangladesh, Bangladesh); Nazia Zaman (American International University-Bangladesh, Bangladesh)	
TS 3 – 07	Flower Pollination Algorithm for Optimal Control in Multi-Machine System with GUPFC.....	265
	Mohammad Musofa Mulya, Pambudy (Gadjah Mada University, Indonesia)	
TS 3 – 08	Frequency Dependent Model of Underground Cables for Harmonic Calculations in Frequency Domain.....	271
	Kaveh Malekian (Chemnitz University of Technology, Germany); Uwe Schmidt (Dresden University of Technology, Germany); Abdullah Hoshmeh (Chemnitz University of Technology, Germany); Ali Shirvani (TU Chemnitz, Germany)	
TS 3 – 09	Fuzzy Logic Principles for Wind Speed Estimation in Wind Energy Conversion Systems.....	278
	Agus Naba (University of Brawijaya, Indonesia)	
TS 3 – 10	Investigation and Modeling of Transient Voltage Stability Problems in Wind Farms with DFIG and Crowbar System.....	282
	Kaveh Malekian (Chemnitz University of Technology, Germany); Uwe Schmidt (Dresden University of Technology, Germany); Ali Shirvani (TU Chemnitz, Germany); Wolfgang Schufft (University of Technology Chemnitz, Germany)	
TS 3 – 11	Magnetic Flux Distribution Due to the Effect of Stator-Rotor Configuration in the Axial Machine.....	290
	Danang Wijaya (UGM, Indonesia); Nobal Rahadyan (Universitas Gadjah Mada, Indonesia); Husni Ali (UGM, Indonesia)	
TS 3 – 12	Maximum Power Point Tracking Algorithm for Photovoltaic System Under Partial Shaded Condition by Means Updating β Firefly Technique.....	296
	Yanuar Safarudin (Institut Teknologi Sepuluh Nopember, Indonesia); Ardyono Priyadi (ITS, Indonesia); Mauridhi Purnomo (Institut of Technology Sepuluh Nopember, Indonesia); Margo Pujiantara (ITS, Indonesia)	
TS 3 – 13	Multi-Resolution Complex Image Method of Horizontal Multilayer Earth.....	301
	Qi Yang (Wuhan University, P.R. China)	
TS 3 – 14	On the Potential and Progress of Renewable Electricity Generation in Bali.....	307
	Satya Kumara (Udayana University, Bali, Indonesia); Wayan G. Ariastina (Udayana University, Indonesia); I Sukerayasa (Udayana University, Indonesia); Ida Giriantari (Udayana University, Bali, Indonesia)	
TS 3 – 15	Optimal Configuration of PV-Wind turbine-Grid-Battery in Low Potency Energy Resources.....	313
	D Fittrin (Universitas Gadjah Mada, Indonesia); D Wijaya (Universitas Gadjah Mada, Indonesia); Sasongko Pramono Hadi (Gadjah Mada University, Indonesia)	
TS 3 – 16	Optimal Solution of Reliability Constrained Unit Commitment Using Hybrid Genetic Algorithm-Priority List Method.....	319
	Sarjiya Sarjiya (Gadjah Mada University, Indonesia); Arief Budi Mulyawan (Gadjah Mada University, Indonesia); Andi Sudiarmo (Gadjah Mada University, Indonesia)	
TS 3 – 17	Partial Discharge Analysis Using PCA and ANN for the Estimation of Size and Position of Metallic Particle Adhering to Spacer in Gas-Insulated System.....	325
	Firmansyah Nur Budiman (Universitas Gadjah Mada, Indonesia); Yasin Khan (King Saud University, Saudi Arabia)	
TS 3 – 18	Quantum Neural Network for State of Charge Estimation.....	331
	Kevin Gausultan Hadith Mangunkusumo (Universitas Gadjah Mada, Indonesia); Danang Wijaya (UGM, Indonesia); Yung-Ruei Chang (Institute of Nuclear Energy Research, Atomic Energy Council, Taiwan); Yih-Der Lee (Institute of Nuclear Energy Research, Taiwan); Kuo Lung Lian (National Taiwan University of Science and Technology, Taiwan)	
TS 3 – 19	Reducing Induction Motor Starting Current Using Magnetic Energy Recovery Switch (MERS).....	336
	Danang Wijaya (UGM, Indonesia); Sholihatta Aziz (UGM, Indonesia); Hartanto Prabowo (UGM, Indonesia)	
TS 3 – 20	The Dynamic Performance of Grid-Connected Fixed-Speed Wind Turbine Generator.....	342
	Husni Rois Ali (UGM, Indonesia)	
TS 3 – 21	TVAC PSO for Modal Optimal Control POD and PSS Coordination in UPFC.....	347
	Rian Fatah Mochamad (UGM, Indonesia); Sasongko Pramono Hadi (Gadjah Mada University, Indonesia); Mokhammad Setyonegoro (UGM, Indonesia)	

➤ Session 4. Electronics, Circuits, and Systems

TS 4 – 01	A Face Detector Based on Color and Texture	354
	Mohammad Reza Mahmoodi (Isfahan University of Technology, Iran); Sayed Masoud Sayedi (Isfahan University of Technolgy, Iran)	
TS 4 – 02	Analysis of Single Excitation Signal for High Speed ECVT Data Acquisition System	360
	Arbai Yusuf (CTECH Labs Edwar Technology Co., Indonesia); Imamul Muttakin (CTECH Labs Edwar Technology Co., Indonesia); Wahyu Widada (CTECH Labs Edwar Technology Co., Indonesia); Warsito P. Taruno (CTECH Labs Edwar Technology Co., Indonesia)	
TS 4 – 03	Pulley's Clamping Force and Axial Position Measurements for Electro-mechanical Continuously Variable Transmission in Automotive Applications.....	366
	Bambang Supriyo (Universiti Teknologi Malaysia, Malaysia); Kamarul Tawi (Universiti Teknologi Malaysia, Malaysia); Mohd Che Kob (Universiti Teknologi Malaysia, Malaysia); Izhari Mazali (Universiti Teknologi Malaysia, Malaysia); Mohd Che Kob (Universiti Teknologi Malaysia, Malaysia)	
TS 4 – 04	Reconfigurable Hardware Implementation of Gigabit UDP/IP Stack Based on Spartan-6 FPGA	370
	Mohammad Reza Mahmoodi (Isfahan University of Technology, Iran); Sayed Masoud Sayedi (Isfahan University of Technolgy, Iran); Batul Mahmoodi (Telecommunication Company of Isfahan, Iran)	
TS 4 – 05	The Performance of Three-Phase Four-Wire Grid-Connected Inverter with Enhanced Power Quality	376
	Susatyo Handoko (Universitas Gadjah Mada, Indonesia); Sasongko Pramono Hadi (Gadjah Mada University, Indonesia); Suharyanto Suharyanto (Gadjah Mada University, Indonesia); Eka Firmansyah (UGM, Indonesia)	
TS 4 – 06	Underwater Sound Propagation Characteristics At Mini Underwater Test Tank with Varied Salinity and Temperature.....	381
	Niken Yuwono (Institut Teknologi Sepuluh Nopember, Indonesia); Dhany Arifianto (Institut Teknologi Sepuluh Nopember, Indonesia); Endang Widjiati (Institut Teknologi Sepuluh Nopember, Indonesia); Wirawan Wirawan (Institut Teknologi Sepuluh Nopember, Indonesia)	

➤ Session 5. Control Systems

TS 5 – 01	A Neural Network Structure with Parameter Expansion for Adaptive Modeling of Dynamic Systems	388
	Erwin Sitompul (President University, Indonesia)	
TS 5 – 02	A New Approach in Self-Generation of Fuzzy Logic Controller by Means of Genetic Algorithm	394
	Erwin Sitompul (President University, Indonesia); Iksan Bukhori (President University, Indonesia)	
TS 5 – 03	Double Target Potential Field.....	400
	Ferry Manalu (Universitas Katolik Indonesia Atma Jaya, Indonesia)	
TS 5 – 04	Robust Residual Generation for Sensor Fault Isolation in Systems with Structured Uncertainty.....	405
	Samiadji Herdjunto (Gadjah Mada University, Indonesia); Adhi Susanto (Universitas Gadjah Mada, Indonesia); Oyas Wahyunggoro (UGM, Indonesia)	
TS 5 – 05	Design of Decoupled Repetitive Control for MIMO Systems	411
	Edi Kurniawan (Indonesian Institute of Sciences, Indonesia); Riyo Wardoyo (Indonesian Institute of Sciences, Indonesia); Oka Mahendra (Indonesian Institute of Sciences, Indonesia)	

Session 1

Software Engineering,
Services and Information
Technology

A Real Time Mission-Critical Business Intelligence for Development of Mixture Composition on Aromatherapy Product Based on Customer Personality Type

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Abstract—Aromatherapy products, like spa mixture, scrub, soap, perfume, and others are individual and very subjective preferences which have high value of business. They require for rapid responses while fulfilling customer needs and mix ordered active note to serve customer preferences. Such requirement needs a real time mission-critical business intelligence which ensures effectiveness and efficiency on fulfilling customer need. In this paper, the objectives are to acquire and to formulate customer preference requirement on aromatherapy product in real time mode. Main characteristics are on key performance indicators (KPI) and displayed them for evaluation in form of dashboard. The formulation worked with sort of databases which filled by customer interaction in real time mode to determine best aromatherapy personal mixture by using quantification theory type 1 (QTT-1) method. QTT-1 is an effective analysis method for building a mathematical model of the relationships between customer personality type and aromatherapy mixture compositions. Dashboard generated from KPI ease the decision making on each element in business intelligence. Further personality approaches are needed to cover each specific requirement on different group of customers.

Keywords—*real time mission-critical business intelligence; aromatherapy; personality; quantification theory type 1*

I. INTRODUCTION

Aromatherapy product is defined as a product that has essential oils and other aromatic plant compounds which are aimed at improving a person's health or mood [1]. Aromatherapy products, like scrub, soap, perfume, and others product are an individual and very subjective preference which cope high value of business. In common spa service, the therapist usually combines the aromatherapy mixture composition based on their customer personality or emotional condition. They required for rapid responses while fulfill customer need and ordered mixture of active note to serve the customer preferences. Such requirement needs a system in real time condition to ensure effectiveness and efficiency on fulfilling customer need.

Considering this condition, real time decision support gained great attention. Concepts such as active warehousing, real time analytics [2, 3] and real time warehousing became hot topics of interest to firms [4]. Real time mission-critical business intelligence is the way to speed up the flow of information and to deliver information with minimum latency in order to achieve competitive advantage. In other words, it delivers information in a range from milliseconds to a few seconds after the business event. Business Intelligence (BI) is a multi-dimensional concept with collection of tools and techniques that aims to identify information needs and process the data and information gathered into useful and valuable managerial knowledge and intelligence [5]. While traditional BI presents historical information to user analysis, real time mission-critical BI compares current business event with historical patterns to detect problems or opportunities automatically [4].

In this paper, we proposed real time mission-critical business intelligence for mixture composition development on aromatherapy product based on the customer personality type. There are two main reasons that make real time mission-critical business intelligence becomes necessary on aromatherapy product development. First, the conditions and environments in which aromatherapy business are unpredictable. Customer preferences change over the time and they require for rapid responses while fulfilling customer needs. Secondly, the implementation of real time mission-critical business intelligence is supported by advances technology, especially the internet and modern information and communication technology so almost all company data source could be made accessible over an intranet and or internet.

The paper objectives are to acquire and formulate customer preference requirement on aromatherapy product in real time mode. We focus on aromatherapy product development especially on aromatherapy perfume and its active notes (top note, middle note, and base note) as the mixture composition. Specifically, in this paper, we discuss the requirement of real time mission-critical business intelligence for aromatherapy mixture composition development based on customer

personality in Section II, quantitative formulation for aromatherapy design based on customer personality type in Section III, computational experiment in Section IV, and conclusion in Section V.

II. REQUIREMENT OF REAL TIME MISSION-CRITICAL BUSSINESS INTELLIGENCE

A. The Analysis of Real Time Mission- Critical Business Intelligence

The requirement of real time mission-critical business intelligence needs to be analyzed. An analysis can produce a system to improve the efficiency and effectiveness of the system especially in order to formulate the mixture composition of aromatherapy perfume based on customer personality type. Generally, as a system, real time mission-critical business intelligence consists of five components: input, process, output, stakeholders, and key performance indicator (KPI). All components work in its design environment as a boundary system.

This system required customer preferences and product samples as its main inputs. For this purpose, customer preferences were obtained in a real time condition when customer orders a personal product. At the same time product samples were collected per batch in the spa service. This system resulted in two outputs, namely formulation of aromatherapy personal design and aromatherapy market design. The system consists of two stakeholders (customer and spa service) and two KPIs, there are customer preferences and design category score. The environment design of aromatherapy product development is illustrated in Fig. 1.

In this real time mission-critical business intelligence, three databases were available to serve customer profile data, product sample data, and customer preference data. All databases integrated in the data warehouse. From this data warehouse, the proposed system processed the data using QTT-1 method and obtained the information about aromatherapy mixture composition that fits with customer personality type. The design of data flow which transforms data into information is represented in Fig. 2.

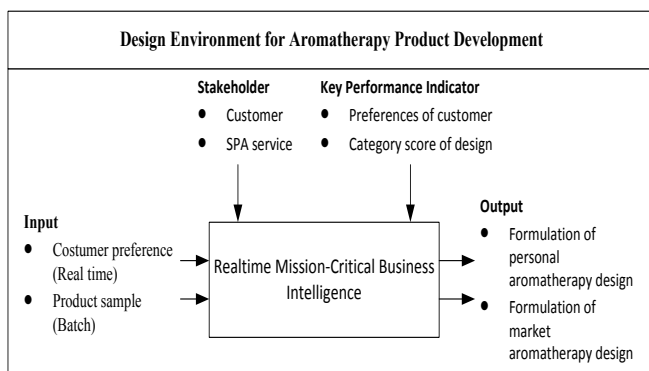


Fig. 1. Scheme of real time mission-critical business intelligence

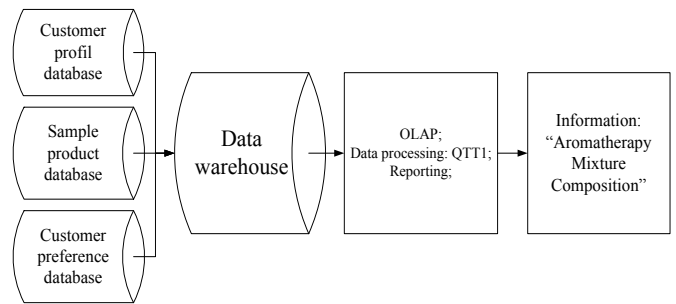


Fig. 2. Design of data flow

B. Data Requirement

The collection of product sample is defined as P_s where $s = 1, 2, \dots, k$. Then we identify its Brand (B_s) and mixture composition (X_{ijs}) of i^{th} design element, j^{th} category, and s^{th} sample product. From the identification, we classify the mixture composition into three categories; there are top note (X_{i1s}), middle note (X_{i2s}), and base note (X_{i3s}). The following process classified all product samples into their mixture composition and stored it in sample product database. The data structure of this database is represented in Table 1.

TABLE 1. DATA STRUCTURE OF SAMPLE PRODUCT DATABASE

No.	Brand	Top note	Middle note	Base note
P_1	B_1	X_{i11}	X_{i21}	X_{i31}
P_2	B_2	X_{i12}	X_{i22}	X_{i32}
...
P_k	B_k	X_{i1k}	X_{i2k}	X_{i3k}

In the same time, we collected the customer profile ($C_p = C_{p1}, C_{p2}, \dots, C_{pn}$) and identify their name (M_r), Gender ($G_r = \{\text{"male"}, \text{"female"}\}$), Age ($A_r = \{\text{integer number}\}$), email (E_r), and also identify their personality (S_{tr}) into four categories ($S_{tr} = \{\text{"sanguine"}, \text{"choleric"}, \text{"melancholy"}, \text{"phlegmatic"}\}$; where $t = 1,2,3,4$). All data about customer profiles are saved in customer profile database which is represented in Table 2.

TABLE 2. DATA STRUCTURE OF CUSTOMER PROFILE DATABASE

ID	Name	Gender	Age	Personality	Email
C_1	M_1	G_1	A_1	S_{1t}	E_1
C_2	M_2	G_2	A_2	S_{12}	E_2
...
C_n	M_n	G_n	A_n	S_{1n}	E_n

The questionnaire which contained data about product mixture composition and customer personality consist each customer inquiry who wants to order the personal product. This step obtained the real time preferences ($Y_{11}, Y_{12}, \dots, Y_{nk}$) from customer r^{th} to the product samples s^{th} . This data was stored in customer preference database which is represented in Table 3.

TABLE 3. DATA STRUCTURE OF CUSTOMER PREFERENCE DATABASE

ID	Personality	P ₁	P ₂	P ₃	...	P _k
C ₁	S ₁₁	Y ₁₁	Y ₁₂	Y ₁₃	...	Y _{1k}
C ₂	S ₁₂	Y ₂₁	Y ₂₂	Y ₂₃	...	Y _{2k}
...
C _n	S _{1n}	Y _{n1}	Y _{n2}	Y _{n3}	...	Y _{nk}

All available data were then fed into QTT-1 formulation to process the data and build the formulation of personal aromatherapy product for each customer inquiry. However, we have to use numerous data to build the formulation of market aromatherapy product to meet the standard number of respondent which can represent the whole customer preference. In the other word, “if data of customer preference is equal or more than standard, then formulate the market product design based on customer personality”. The standard numbers of respondent were set by using Slovin method (1) as follows.

$$n = \frac{N}{1+Ne^2} \tag{1}$$

Where:

- n = sample size
- N = number of population
- e = level of error

III. QUANTITATIVE FORMULATION FOR AROMATHERAPY DESIGN BASED ON CUSTOMER PERSONALITY TYPE

Aromatherapy design formulation which was based on customer personality type was then obtained as a result of the interaction between customer personality and mixture composition elements. We give a questionnaire to consumers in order to evaluate aromatherapy product based on their preferences. Semantic differential scales (7 scales) were used here. Scale with the two extremes “not like at all” and “like very much”.

The results of the evaluation were analyzed by using quantification theory type 1 (QTT-1) method to obtain the aromatherapy design formulation which answers the second objective of this paper. The QTT-1 considered as a quantitative and categorical multiple regression analysis method, which allowed inclusion of independent variables that are categorical and qualitative in nature. The QTT-1 consist of the followings six steps [6]:

Step1: Defining the relational model associated with the measured score of experimental sample with respect to customer preferences. The categorical multiple regression model can be defined as in (2):

$$\hat{y}_s^k = \sum_{i=1}^E \sum_{j=1}^{C_i} \beta_{ij} x_{ijs} + \varepsilon \tag{2}$$

Where

- \hat{y}_s^k = the predicted value of criterion variable for the sth product sample on the kth image word.
- i = the index of design element
- E = the number of design element
- j = the index of category

- C_i = the number of category of the ith design element
- ε = a stochastic variable whose expectation value E(ε)=0
- β_{ij} = the category score of the jth style within the ith design element
- x_{ijs} = the coefficient of the dummy variable

Step 2: Calculating the standardized regression coefficients (4) and standardized constant in model (5). The model of categorical multiple regression analysis can be redefined as (3):

$$\hat{y}_s^k = \sum_{i=1}^E \sum_{j=1}^{C_i} \beta_{ij}^* x_{ijs} + \bar{y}_s^k \tag{3}$$

and

$$\beta_{ij}^* = \beta_{ij} - \frac{1}{n} \sum_{j=1}^{C_i} \beta_{ij}^* x_{ijs} \tag{4}$$

$$\bar{y}_s^k = \frac{1}{n} \sum_{j=1}^{C_i} y_s^k \tag{5}$$

Where:

- β_{ij}^{*} = standardized coefficient of explanatory variables
- \bar{y}_s^k = standardized constant in model

Step 3: Determining the matrix correlated component regression (CCR) of correlation coefficient of all variables.

Step 4: Calculating the multiple correlation coefficient (R) that is regarded as the relational degree of external criterion variable and explanatory variables.

Step 5: Calculating the partial correlation coefficients (PCC) of design elements that indicate the relationships between product element and a product image.

Step 6: Determining the statistical range of categorical variable which indicates its contribution degree to the prediction model with respect to a given product image.

IV. COMPUTATIONAL EXPERIMENT

A. Identification of Aromatherapy Mixture Composition

There were 15 aromatherapy products (perfume) that were available in particular spa service and in common are classified based on their scent structure. Perfumes have three set notes which composite the scent harmonically; there are top note, middle note, and base note.

Top note perceived immediately upon application of a perfume, top note consist of small, light molecules that evaporate quickly. Middle note is the scent of a perfume that emerges just prior to when the top note dissipate. Base note is the scent of a perfume that appears close to the departure of the middle note. The base and middle note together are the main theme of a perfume. Base note bring depth and solidity to a perfume.

In Table 4, the identification of the aromatherapy included mixture composition (X_{ijs}), where X_{11s} = {1, 2, 3}, X_{12s} = {1, 2, 3, 4, 5}, and X_{13s} = {1, 2, 3, 4, 5, 6, 7}. After the identification of the mixture composition in each product based on their design elements, the result of the classification was presented in Table 5.

TABLE 4. IDENTIFICATION OF AROMATHERAPY PRODUCTS (PERFUME) BASED ON THEIR SCENT STRUCTURE

Type	Scent structure		
	Top note (X ₁)	Middle note (X ₂)	Base note (X ₃)
1	Cajuput	Bay	Balsam Peru
2	Cinnamom	Black Pepper	Cassia
3	Citrus	Cardamom	Cedar wood
4		Chamomile	Cinnamon
5		Cypress	Clove
6			Frankincense
7			Ginger

TABLE 5. CLASSIFICATION OF SCENT DESIGN ELEMENTS

No. Samples	X ₁	X ₂	X ₃
1	2	3	4
2	1	1	3
3	2	5	5
...
15	2	5	6

B. Identification of Customer Personality Type

In this section the customer personality was then indicated by using Hippocrates and Galen theory who classify the personality into four basic personality types: Melancholy, Phlegmatic, Sanguine, and Choleric [7]. These personality types are the most popular and the oldest classification of personality [8]. The classification of the personality is presented in Table 6.

Choleric are considered to be leader and commander types, being dominant, strong, decisive, and occasionally arrogant. Melancholy personality types are described to be the mental types, with their personality displaying a strong emphasis on thinking, evaluation, and assessment. Sanguine are a social personality type, displaying characteristics such as a predisposition to socialize and entertain. Phlegmatic are described as having a flat-type personality, being laid back and desiring a peaceful environment above all else.

TABLE 6. CLASSIFICATION OF THE PERSONALITY TYPE

Personality types	Characteristic of personality
Choleric	Strong, adventurous, powerful, dominant.
Melancholy	Analytical, individualist, details, planner, perfectionist.
Sanguine	Animated, cheerful, humorist, extrovert, trendsetter, sociable.
Phlegmatic	Friendly, easy going, peaceful, shy, adaptable

C. Formulation of Personal Aromatherapy Product Design

First we collected questionnaire for evaluate the existing samples product by customer preference based on their personality. These questionnaires involve 15 samples product and the respondent who order the personal product. There were 7 scales of semantic differential to evaluate the questionnaire.

The result of hypothetical data of this questionnaire is presented in Table 7.

TABLE 7. EVALUATING SAMPLES PRODUCTS BY CUSTOMER PREFERENCES

No sample	X ₁	X ₂	X ₃	level of preference
1.	2	3	4	6
2.	1	1	3	2
3.	2	5	5	3
...
15.	2	5	6	5
Type of personality				Sanguine

We deploy R language version 3.1.0 [9] on QTT-1 analysis to examine the relationship between the three product scent elements and customer preference. In this paper, 15 independent variables and 1 dependent variable are used. The result of QTT-1 analysis is given in Table 8 and the dashboard is represented in Fig. 3. In Table 8, the highest variable of partial correlation coefficient is “top note”, meaning that “top note” primarily affects the customer’s product preference. The category score of three selected values of the “top note” shows that the consumer’s emotional feeling prefers to “citrus” as a “top note”.

R indicated multiple correlation coefficients which determine how well estimation model fits the observed data and R² indicates coefficient of determination which shows how well data points fit a statistical model [10]. R should be more than 0.8 and must be more than 0.6 for an evaluation data model [11]. In this experiment, we obtained that all model has multiple correlation coefficient more than 0.8. This means that the model fits the observed data.

TABLE 8. RESULT OF QTT-1 ANALYSIS

Scent element		Sanguine personal product	
		Category score	PCC
X ₁	X ₁₁	-1.322	0.980
	X ₁₂	-0.017	
	X ₁₃	2.678	
X ₂	X ₂₁	1.823	0.954
	X ₂₂	-0.177	
	X ₂₃	-0.699	
	X ₂₄	-1.786	
X ₃	X ₂₅	0.084	0.978
	X ₃₁	-1.768	
	X ₃₂	-2.768	
	X ₃₃	-1.420	
	X ₃₄	-0.725	
	X ₃₅	0.841	
	X ₃₆	5.841	
X ₃₇	1.058		
Constant		4.267	
R		0.971	
R ²		0.943	

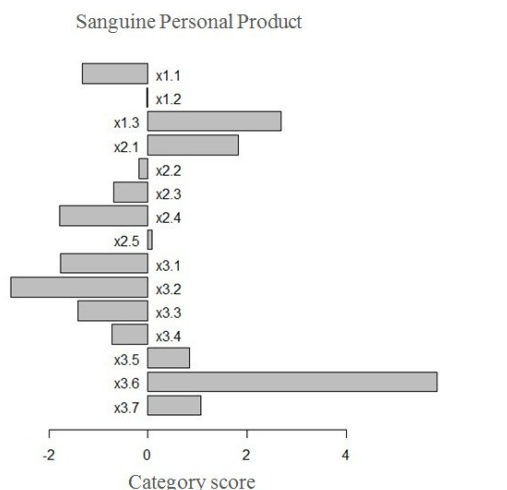


Fig. 3. Dashboard of product personal design

TABLE 9. DESIGN SUPPORT INFORMATION FOR THE NEW AROMATHERAPY PRODUCT DESIGN

Design	Top note	Middle note	Base note
Sanguine personal product	Citrus	Bay	Frankincense

D. Formulation of Aromatherapy Product Design Based on Customer Personality Type

We collected each data of personal order in our database, so that we can classify them into their personality type and help product designer on developing the new concept design of aromatherapy product for each personality type. In this paper we use hypothetical data. We assume that we have collecting 50 data from each personality category. This means that we have total 200 data from our database. We use the average of 50 data from each personality category. Data of evaluating sample products is represented in table 10.

TABLE 10. DATA OF EVALUATING SAMPLE PRODUCTS

No sample	X ₁	X ₂	X ₃	Choleric	Melancholy	Sanguine	Phlegmatic
1.	2	1	3	3.746	1.901	3.327	2.377
2.	1	3	1	5.238	5.381	4.877	1.998
3.	2	1	7	5.914	3.046	6.798	6.501
...
15.	2	5	4	2.474	5.451	5.693	3.920

The QTT-1 method computation was generated by using R Language and the result was represented in Table 11. As seen, the visualization of this result in the dashboard was represented in Fig. 4. From the dashboard, we will know instantly the recommendation of developing the combination

aroma on aromatherapy product. The values in each category show the influence level of aromatherapy product. We recommended the highest positive value of category score in each scent category as a scent component in their category.

TABLE 11. FORMULATION OF SCENT COMPOSITION FOR AROMATHERAPY PRODUCTS BASED ON CUSTOMER PERSONALITY

Scent element		Choleric		Melancholic		Sanguine		Phlegmatic	
		Category score	PCC	Category score	PCC	Category score	PCC	Category score	PCC
X ₁	X ₁₁	0.026	0.929	1.703	0.922	-1.974	0.942	2.148	0.969
	X ₁₂	-1.136		-2.497		2.238		-6.098	
	X ₁₃	2.221		1.590		-0.528		7.902	
X ₂	X ₂₁	-0.690	0.930	2.441	0.950	-0.732	0.800	3.490	0.964
	X ₂₂	-0.203		-0.599		0.767		-2.955	
	X ₂₃	2.537		-0.708		0.485		2.616	
	X ₂₄	-0.436		-4.461		0.710		-5.738	
	X ₂₅	-0.095		3.716		-1.620		4.923	
X ₃	X ₃₁	-1.344	0.967	0.282	0.929	1.483	0.957	-6.653	0.969
	X ₃₂	-3.598		-4.508		2.210		-8.979	
	X ₃₃	2.254		-2.320		-2.281		1.983	
	X ₃₄	-0.703		1.194		-0.078		0.579	
	X ₃₅	-0.669		0.899		-0.813		0.720	
	X ₃₆	-0.098		1.276		2.591		4.517	
	X ₃₇	3.332		0.064		0.140		4.593	
Constant		4.020		4.104		4.883		3.888	
R		0.941		0.910		0.943		0.943	
R ²		0.885		0.828		0.889		0.889	

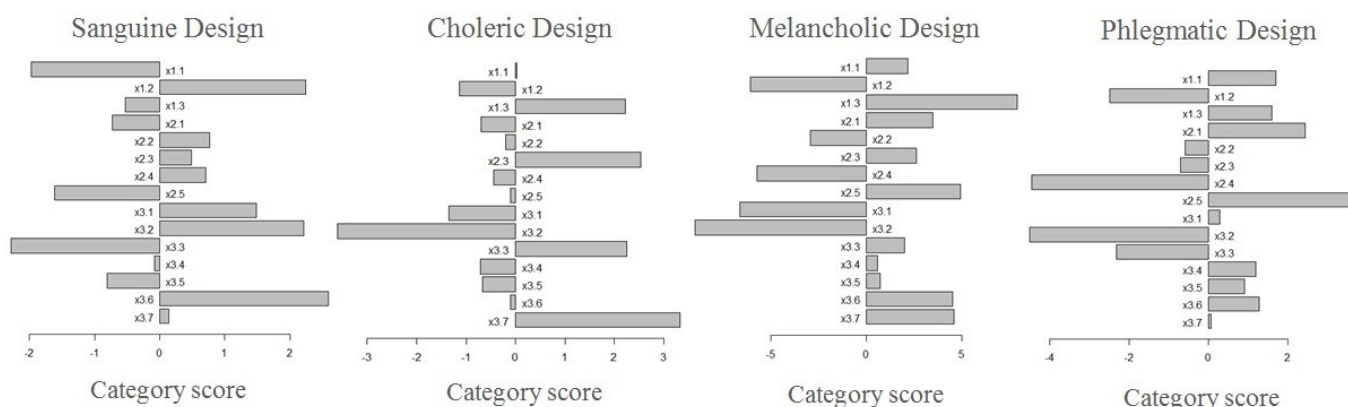


Fig. 4. Design formulation dashboard of each personality

The design support information of the new aromatherapy product design based on customer personality is represented in Table 12. By implementing this system, we can develop the personal aroma formulation of aromatherapy product in real

time mode. And we can also develop the aromatherapy product based on customer personality by using all data that we collect from customer order for personal product.

TABLE 12. DESIGN SUPPORT INFORMATION FOR THE AROMATHERAPY PRODUCT DESIGN BASED ON CUSTOMER PERSONALITY

Design	X ₁	X ₂	X ₃
	Top note	Middle note	Base note
Choleric	Citrus	Cardamom	Ginger
Melancholic	Cajuput	Cypress	Frankincense
Sanguine	Cinnamon	Black Pepper	Frankincense
Phlegmatic	Citrus	Cypress	Ginger

V. CONCLUSION

The result of acquirement from real time mission-critical business intelligence for aromatherapy mixture composition development based on customer personality type showed that the system required two inputs (customer preferences and product samples), two outputs (formulation of both aromatherapy personal and market design), two stakeholders (customer and spa service), and two KPIs (customer preferences and design category score). By using QTT-1 method we obtained the mixture composition formulation which is visualized by the dashboard that accelerates in translating customer preference requirement on aromatherapy product in real time mode. The dashboard generated from KPI ease the decision making on each element in real time mission-critical business intelligence and it could help a spa service to ensure effectiveness and efficiency on fulfilling customer need rapidly based on their personality type.

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