

The 5th International Conference on Information Technology for Cyber and IT Service Management **CITSM 2017**



**STIKOM Bali
Convention Hall**

August 8, 2017 - August 10, 2017

**Proceedings of
CITSM 2017**

ISBN : 978-1-5386-2739-6

Organized by :



Partner & Co-Organizers :



2017 5th International Conference on Cyber and IT Service Management

Convention Hall, STIKOM Bali

August 8-10, 2017



ISBN : 978-1-5386-2737-2

IEEE Catalog Number : CFP1737Z-PRT

2017 5th International Conference On Cyber And IT Service Management (CITSM)

Convention Hall, STIKOM Bali

Phone: (0361) 244445

Email : contact.citsm@uinjkt.ac.id

Website : <http://citsm.id/>

August 8-10, 2017

ISBN : 978-1-5386-2737-2

IEEE Catalog Number : CFP1737Z-PRT

2017 5th International Conference On Cyber And IT Service Management (CITSM)

Copyright ©2017 by the Institute of Electrical and Electronics Engineers, Inc. All rights reserved.

Copyright and Reprint Permission

Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law, for private use of patrons, those articles in this volume that carry a code at the bottom of the first page, provided that the per-copy fee indicated in the code is paid through the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

Other copying, reprint, or reproduction requests should be addressed to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331.

ISBN : 978-1-5386-2737-2

IEEE Catalog Number : CFP1737Z-PRT

Additional copies of this publication are available from

Curran Associates, Inc.

57 Morehouse Lane

Red Hook, NY 12571 USA

+1 845 758 0400

+1 845 758 2633 (FAX)

email: curran@proceedings.com

PREFACE

Assalaamu 'alaykum warahmatullahi wabarakaatuh,

The CITSM 2017 is in the general area of communication and information technology. It provides a forum for presenting and discussing the latest innovations, results and developments in IT Management & organizations, IT Applications, Cyber & IT Security, and ICT. The main objective of this conference is to provide a forum for engineers, academia, scientist, industry, and researchers to present the result of their research activities in the field of Computer and Information Technology. The primary focus of the conference is to create an effective medium for institutions and industries to share ideas, innovations, and problem solving techniques.

There are almost 205 papers submission and only 107 papers are accepted and 101 papers have been registered. Accepted papers will be presented in one of the regular sessions and will be published in the conference proceedings volume. All accepted papers are submitted to IEEEExplore. IEEE Conference Number: # 41401, IEEE Catalog Number: CFP1737Z-PRT, ISBN: 978-1-5386-2737-2, CFP1737Z-USB, ISBN: 978-1-5386-2738-9

On behalf of the CITSM organizers, we wish to extend our warm welcome and would like to thank for the all Keynote Speakers, Reviewers, authors, and Committees, for their effort, guidance, contribution and valuable support. Last but not least, thanks to all lecturers and staffs of the Faculty of Science & Technology, UIN Syarif Hidayatullah Jakarta and STIKOM BALI and other parties that directly and indirectly make this event successful.

Wa billahi taufiq wal hidaayah.

Wallahul muwaffiq ila aqwamit-tharieq.

Wasalaamu 'alaykumu warahmatullahi wabarakaatuh.

Husni Teja Sukmana (Organizing Chair)

Technical Program Committee

TPC Organization:

TPC Chair

- Ismail Khalil, Institute of Telecooperation Johannes Kepler University Linz, Austria

TPC Secretariat

Faculty of Science and Technology, Syarif Hidayatullah State Islamic University Jakarta, Indonesia

TPC Co-Chair:

- I Gede Putu Wirarama Wedashwara Wirawan, The School of Information Management and Computer Engineering (STIKOM) Bali, Indonesia
- Husni Teja Sukmana, Syarif Hidayatullah State Islamic University Jakarta, Indonesia
- Suryadiputra Liawatimena, IEEE Indonesian Section Computer Society Chapter, Bina Nusantara University
- Aries Susanto, Ph.D, Syarif Hidayatullah State Islamic University Jakarta

TPC Member:

- Dwiza Riana, STMIK Nusa Mandiri, Indonesia
- Ankhaa Bayar, National University of Mongolia,
- TB Maulana, Gunadarma University, Indonesia
- Andrew Tanny Liem, Klabat University, Indonesia
- Khamis Alarabi, International Islamic University, Malaysia
- Nashrul Hakiem, Syarif Hidayatullah State Islamic University Jakarta, Indonesia
- Masao Okano, Bunkyo University, Japan
- Adila A. Krisnadhi, Wright state University, USA
- Akram M. Zeki, International Islamic University, Malaysia
- Djoko Soetarno, Coris Research Center, Indonesia
- Afzan Salleh, International Islamic University, Malaysia
- Alfida Hasbullah, Syarif Hidayatullah State Islamic University Jakarta, Indonesia
- Ali A. Alwan Aljuboori, International Islamic University, Malaysia
- Madihah S. Abd. Aziz, International Islamic University, Malaysia
- Taqwa Hariguna, STIMIK AMIKOM Purwokerto, Indonesia
- Bernardo Nugroho Yahya, Ulsan National Institute of Science and Technology, South Korea
- Muharman Lubis, Telkom University, Indonesia
- Kusrini, Amikom Jogjakarta University, Indonesia
- Tedjo Darmanto, STIMIK AMIK Bandung, Indonesia
- Muhammad Izman Herdiansyah, Bina Darma University, Indonesia
- Rahmat Widia Sembiring, Medan State Polytechnic, Indonesia
- Sonny Zulhuda, International Islamic University Malaysia, Malaysia
- Murni Mahmud, International Islamic University Malaysia, Malaysia
- Aang Subiyakto, Syarif Hidayatullah State Islamic University Jakarta, Indonesia
- Imam Marzuki Sofi, Syarif Hidayatullah State Islamic University Jakarta, Indonesia
- Winda Astuti, Bina Nusantara University, Indonesia
- Lookman Adebiyi, International Islamic University Malaysia, Malaysia
- Agus Rifai, International Islamic University Malaysia, Malaysia
- Sri Hartati, Gajah Mada University, Indonesia

- Rika Rosnelly, Potensi Utama Univerity, Indonesia
- Qomarul Huda, Syarif Hidayatullah State Islamic University Jakarta, Indonesia
- Samsuryadi Sahmin, Sriwijaya University, Indonesia
- Nurhayati Buslim, Syarif Hidayatullah State Islamic University Jakarta, Indonesia
- Diyah Puspitaningrum, Bengkulu University, Indonesia
- Dini Handayani, International Islamic University Malaysia, Malaysia
- Zeeshan Bhatti, University of Sindh, Pakistan
- Heru Agus Santoso, Dian Nuswantoro University, Indonesia
- Affandy, Dian Nuswantoro University, Indonesia
- Iwan Setyawan, IEEE Computer Society, Indonesia
- Raini Hasan, International Islamic University Malaysia, Malaysia
- Meyliana, Bina Nusantara University, Indonesia
- Syopiansyah Jayaputra, Syarif Hidayatullah State Islamic University Jakarta, Indonesia
- Husnayati Hussin, International Islamic University Malaysia, Malaysia
- Roslina Othman, International Islamic University Malaysia, Malaysia
- Zahidah Zulkifli, International Islamic University Malaysia, Malaysia
- Martianus Frederic Ezerman, Nanyang Technology University, Singapore
- Leon Andretti Abdillah, Bina Darma University, Indonesia
- M Ary Heryanto, Dian Nuswantoro University, Indonesia
- Kim Jin Mook, Sunmoon University, South Korea
- Robert P Biuk-Aghai, University of Macau, Taiwan
- Suvdaa Batsuuri, School of engineering and applied sciences, national university of Mongolia, Mongolia
- Houari Sabirin, KDDI Research, Inc, Japan
- Jihye Bae, Sunmoon University, South Korea
- Noor Azura Zakaria, International Islamic University Malaysia, Malaysia
- Abdullah Alkalbani, University of Buraimi, Qatar
- Yudi Agusta, STIKOM Bali, Indonesia
- Ahmad Nurul Fajar, Bina Nusantara University, Indonesia
- Hamwira Yaacob, International Islamic University Malaysia, Malaysia
- Marini Othman, International Islamic University Malaysia, Malaysia
- Mohammad Rasheed, Kuala Lumpur Univerity, Malaysia
- Prihandoko, Gunadarma University, Indonesia
- Jarot Suroso, Bina Nusantara University, Indonesia
- Zaheer Khan, University of the west England, England
- Arief Setyanto, Amikom University, Indonesia
- Muhammad Fachrurrozi, Sriwijaya University, Indonesia
- Shingo Mabu, Yamaguchi University, Japan
- Okfalisa, UIN Riau, Indonesia
- Erna Utami, Amikom University, Indonesia
- Arief Zulianto, Langlanbuana University, Indonesia
- Muhammad Rusli, STIKOM Bali, Indonesia
- Agni Catur Bakti, Samperna University, Indonesia
- Lee Kyong Ohh, Sunmoon University, South Korea
- Hadi Purnawan Satria , Universitas Sriwijaya, Indonesia
- Teddy Mantoro, Samperna University, Indonesia
- Media, Sampoerna University, Indonesia
- Jeong Bae Lee, Busan University of Foreign Study, South Korea
- Fauzan Nurdin, International Islamic University, Malaysia

- Ahmad Nurul Fajar, Bina Nusantara University, Indonesia
- Desmon Alexander, Foresec, Singapore
- Elly Matul Imah, University of Indonesia, Indonesia
- Fauzan Nurdin, International Islamic University Malaysia,
- Ford Lumban Gaol, Bina Nusantara University, Indonesia
- Habib Kassim, PASAS Singapore,
- Ivan Lanovara, Infrastructure University Kuala Lumpur,
- Kuncoro Wastuwibowo, IEEE Indonesia Section
- Marimin, Bogor Agricultural Institute, Indonesia
- Rizal Isnanto, University of Diponegoro, Indonesia
- Sigit Puspito Wigati Jarot, Commissioner, Ministry of Communication & Information Technology
- SM Syed Ali, PASAS Singapore
- Wikan Danar Sunindyo, Bandung Institute of Technology, Indonesia

TABLE OF CONTENT

	Front Matter	ii-iv
	Preface	v
	List of Reviewers	vi-viii
	Table of Content	ix-xix
1	Analysis of Travel Time Computation Accuracy from Crowdsourced Data of Hospitality Application in South of Tangerang City with Estimated Travel Time Method <i>Rizal Broer Bahaweres, Arini, Muhamad Rizka Akbar</i>	1-5
2	Combining of Feature Extraction for Real-time Facial Authentication System <i>I. Intan</i>	6-11
3	Incremental Technique with Set of Frequent Word Item sets for Mining Large Indonesian Text Data <i>Dian Sa'adillah Maylawati, Muhammad Ali Ramdhani, Ali Rahman, Wahyudin Darmalaksana</i>	12-17
4	Crawling and Cluster Hidden Web Using Crawler Framework and Fuzzy-KNN <i>I Gede Surya Rahayuda, Ni Putu Linda Santiari</i>	18-24
5	Internet Service Providers Liability for Third Party Content: Freedom to Operate? <i>Ida Madieha Abdul Ghani Azmi, Suzi Fadhilah Ismail, Mahyuddin Daud</i>	25-29
6	Trust, Risk and Public Key Infrastructure Model on E-Procurement Adoption <i>Herlino Nanang, Ahmad F. Misman, Zahidah Zulkifli</i>	30-35
7	Wiki-MetaSemantik: A Wikipedia-derived Query Expansion Approach based on Network Properties <i>Diyah Puspitaningrum, Gries Yulianti, I.S.W.B. Prasetya</i>	36-41
8	Fast and Efficient Image Watermarking Algorithm using Discrete Tchebichef Transform <i>De Rosal Ignatius Moses Setiadi, T. Sutojo, Eko Hari Rachmawanto, Christy Atika Sari</i>	42-46

9	Diagnosis of Toddler Digestion Disorder using Forward Chaining Method <i>Kasman Rukun, B. Herawan Hayadi, Isra Mouludi, Adyanata Lubis, Safril, Jufri</i>	47-49
10	The Comparation of Text Mining With Naive Bayes Classifier, Nearest Neighbor, and Decision Tree to Detect Indonesian Swear Words on Twitter <i>Wildan Budiawan Zulfikar, Mohamad Irfan, Cecep Nurul Alam, Muhammad Indra</i>	50-54
11	Parallel Evolutionary Association Rule Mining for Efficient Summarization of Wireless Sensor Network Data Pattern <i>Wirarama Wedashwara, Shingo Mabu, Candra Ahmadi</i>	55-60
12	The Implementation of K-Nearest Neighbor Algorithm in Case-Based Reasoning Model for Forming Automatic Answer Identity and Searching Answer Similarity of Algorithm Case <i>Yana Aditia Gerhana, Aldy Rialdy Atmadja, Wildan Budiawan Zulfikar, Nurida Ashanti</i>	61-65
13	The Implementation of E-Learning into Mobile-Based Interactive Data Structure Subject <i>Rismayani, Andi Irmayana</i>	66-70
14	Prototype of Authentication System of Motorcycle Using RFID Implants <i>Marchel Thimoty Tombeng, Haryanto Samuel Laluyan</i>	71-75
15	Implementation of Principal Component Analysis Method for Detection of Chlorine and Bleach in Rice <i>Qadavi Muhammad Sofyan, Arini, Nurul Faizah Rozy</i>	76-80
16	Comparative Study for Better Result on Query Suggestion of Article Searching with MySQL Pattern Matching and Jaccard Similarity <i>Komang Rinantha, Wayan Suryasa</i>	81-84
17	Green Computing Survey Based on User Behavior: A Case Study in Board of Investment and Licensing of Bali Province <i>Luh Gede Surya Kartika, Gede Adhitya Bayu Pramana, I Putu Agus Aditya Satria Wibawa</i>	85-90
18	Explaining Acceptance of E-health Services: An Extension of TAM and Health Belief Model Approach <i>Rinda Wahyuni, Nurbojatmiko</i>	91-97
19	A Review: The Affair of Al-Qur'an and Green Computing <i>Arif Ridho Lubis, Ferry Fachrizal, Halim Maulana</i>	98-102

- | | | |
|----|---|---------|
| 20 | Characteristics Signal Spectrum Analyzer and AWGN with RF Filter Method to reduce interference on the UMTS System | 103-108 |
| | <i>Made Adi Surya Antara</i> | |
| 21 | Assessing Privacy and Readiness of Electronic Voting System in Indonesia | 109-115 |
| | <i>Muharman Lubis, Mira Kartiwi, Yusuf Durachman</i> | |
| 22 | Expert System for Predicting the Early Pregnancy with Disorders using Artificial Neural Network | 116-121 |
| | <i>Dian Sa'adillah Maylawati, Muhammad Ali Ramdhani, Wildan Budiawan Zulfikar, Ichsan Taufik, Wahyudin Darmalaksana</i> | |
| 23 | A Study of Information Technology Infrastructure Library (ITIL) Framework Implementation at the Various Business Field in Indonesia | 122-125 |
| | <i>Andrean Limanto, Azqa Fikri Khwarizma, Imelda, Reinert Yosua Rumagit, Victor Prasetya Pietono, Yohanes Halim, Suryadiputra Liawatimena</i> | |
| 24 | Boosted Classifier and Features Selection for Enhancing Chronic Kidney Disease Diagnose | 126-131 |
| | <i>Made Satria Wibawa, I Made Dendi Maysanjaya, I Made Agus Wirahadi Putra</i> | |
| 25 | Improving Information Performance of Schools in Higher Education through IT Service Management | 132-137 |
| | <i>Sandy Kosasi, Harjanto Prabowo, Dyah Budiastuti</i> | |
| 26 | The Application of Centroid Linkage Hierarchical Method and Hill Climbing Method in Comments Clustering Online Discussion Forum | 138-143 |
| | <i>Okfalisa, Joni Iskandar</i> | |
| 27 | Numerical Simulation to Design Single Mode Fiber Coupler with Fiber Bragg Grating Combination | 144-147 |
| | <i>Saktioto, Rosmeri, Okfalisa, Muhammad Hamdi</i> | |
| 28 | Development of Document Plagiarism Detection Software Using Levensthein Distance Algorithm on Android Smartphone | 148-153 |
| | <i>Nurhayati, Busman</i> | |

29	Routing Protocol RIPng, OSPFv3, and EIGRP on IPv6 for Video Streaming Services <i>Nurhayati, Rahmat Fajar Al Farizky</i>	154-159
30	Framework of Sentiment Annotation for Document Specification in Indonesian Language Base on Topic Modeling and Machine Learning <i>Tata Sutabri, Miftah Ardiansyah</i>	160-165
31	Hybrid Method using HWT-DCT for Image Watermarking <i>Ajib Susanto, De Rosal Ignatius Moses Setiadi, Christy Atika Sari, Eko Hari Rachmawanto</i>	166-170
32	Improving IT Performance through IT Innovation: A Conceptual Model <i>David, Edi Abdurachman, Raymondus Raymond Kosala</i>	171-176
33	Inventory Model of Supply Chain Management 3-Echelon Multi-Tiers <i>Armin Lawi, Nur Ilmiyati Djalal, Aidawayati Rangkuti</i>	177-181
34	Adoption of Information Technology in Business Performance of Small and Medium Enterprises Woven Fabric <i>Susanti Margaretha Kuway, Raymondus Raymond Kosala, Ngatindriatus, Wendy</i>	182-185
35	Toward to Operationalization of Socio-Technical Ontology Engineering Methodology <i>Dana Indra Sensuse, Yudho Giri Sucahyo, Mesnan Silalahi, Ika Arthalia Wulandari, Izzah Fadhilah Akmaliah, Handrie Noprisson</i>	186-192
36	GIS Technology Selection for Visualization of Independent Economic Modeling of Former Woman Migrant Worker (WMW) <i>Kusrini, Muhamad Idris Purwanto, Kusuma Chandra Kirana, Arif Dwi Laksito</i>	193-197
37	Clustering and Profiling of Customers Using RFM for Customer Relationship Management Recommendations <i>Ina Maryani, Dwiza Riana</i>	198-203
38	Contribution of Information Technology through Consumer Engagement to Improve Market Growth of Credit Union <i>Gat, Edi Abdurahman, Stephanus Remond Waworuntu</i>	204-209
39	Delay Analysis of Dynamic Bandwidth Allocation for Triple-Play-Services in EPON	210-215

- 40 Knowledge Management for Creativity Improvement: A Systematic Review 216-223
Pamela Kareen, Dana Indra Sensuse, Elin Cahyaningsih, Handrie Noprisson, Yudho Giri Sucahyo
- 41 Variety and Trends on Geographic Information Systems Research A Literature Study 224-230
Eri Rustamaji
- 42 Decision Support Systems Design on Sharia Financing using Yager's Fuzzy Decision Model 231-234
Aries Susanto, Lisa Latifah, Nuryasin, Aida Fitriyani
- 43 Combining Integrated Sampling Technique with Feature Selection for Software Defect Prediction 235-240
Sukmawati Anggraeni Putri, Frieyadie
- 44 Store Image of Organic Product: Social Responsibility and Trust's Mediator 241-244
Doni Purnama Alamsyah, Oda I. B. Hariyanto
- 45 An Empirical Investigations of User Acceptance of "SCALSA" E-Learning in STIKES Harapan Bangsa Purwokerto 245-250
Hadi Jayusman, Djoko Budiyo Setyohadi
- 46 Strategic Information System Plan for the Implementation of Information Technology at Polytechnic "API" Yogyakarta 251-256
Deny Budiyo, Djoko Budiyo Setyohadi
- 47 Hommons: Hydroponic Management and Monitoring System for an IOT Based NFT Farm Using Web Technology 257-262
Padma Nyoman Crisnapati, I Nyoman Kusuma Wardana, I Komang Agus Ady Aryanto, Agus Hermawan
- 48 'Unsafe' Nutraceuticals Products on the Internet: The Need for Stricter Regulation in Malaysia 263-267
Mahyuddin Daud, Juriah Abd. Jalil, Ida Madieha Abdul Ghani Azmi, Suzi Fadhillah Ismail, Sahida Safuan
- 49 Eye Tracking Analysis of Consumer's Attention to the Product Message of Web Advertisements and TV Commercials 268-272
Masao Okano, Masami Asakawa

50	A Multi-Study Program Recommender System Using ELECTRE Multicriteria Method <i>Linda Marlinda, Yusuf Durachman, Taufik Baidawi, Akmaludin</i>	273-277
51	Comparing RDP and PcolP Protocols for Desktop Virtualization in VMware Environment <i>Louis Casanova, Marcel, Edy Kristianto</i>	278-281
52	Mapping Requirements into E-commerce Adoption Level: A Case Study Indonesia SMEs <i>Evi Triandini, Arif Djunaidy, Daniel Siahaan</i>	282-286
53	Strategic Plan with Enterprise Architecture Planning For Applying Information System at PT. Bestonindo Central Lestari <i>Marianus Omba Riku, Djoko Budiyo Setyohadi</i>	287-292
54	Flow Measurement of Charges and Electricity Costs Monitoring System with Android Based IoT (Case Study: Boarding House Adelina) <i>Nenny Anggraini, Andrew Fiade, Miftahul Fauzan</i>	293-297
55	Concept and Data Model of AK/I Card Digitization as Employment Information Distribution Media <i>Irwan Oyong, Awaludin Abid, Hasnan Afif, Ema Utami</i>	298-303
56	Implementation of TOPSIS Method in the Selection Process of Scholarship Grantee (Case Study: BAZIS South Jakarta) <i>Meinarini Catur Utami, Yuni Sugianti, Ahmad Melani, Yusuf Durachman, A'ang Subiyakto</i>	304-308
57	Feature Selection Based on Genetic Algorithm, Particle Swarm Optimization and Principal Component Analysis for Opinion Mining Cosmetic Product Review <i>Dinar Ajeng Kristiyanti, Mochamad Wahyudi</i>	309-314
58	Design Concepts Smartcoop with Implementing Financial Technology <i>Adji Sukmana, Mihuandayani, Yayak Kartika Sari, Fuad Hasan, Ahmad Sarid Ezra Fathin, Khoirun Nisa, Ema Utami</i>	315-319
59	Smart Data Centre Monitoring System Based On Internet of Things (IoT) (Study Case: Pustipanda UIN Jakarta) <i>Feri Fahrianto, Nenny Anggraini, Hendra Bayu Suseno, Almas Shabrina, Alfatta Reza</i>	320-328

60	Determining Evaluated Domain Process through Problem Identification using COBIT 5 Framework <i>Fitroh, Sahbani Siregar, Eri Rustamaji</i>	329-334
61	The Psychometric and Interpretative Analyses for Assessing the End-User Computing Satisfaction Questionnaire <i>A'ang Subiyakto, Rosalina, Meinarini Catur Utami, Nia Kumaladewi, Syopiansyah Jaya Putra</i>	335-340
62	Comparison of Characteristic of Two and Three Couplers Mach-Zehnder Interferometers <i>Fauzan Al Ayyubi, Ary Syahriar, Sasono Rahardjo, Faisal Ali</i>	341-345
63	A Novel System to Visualize Aerial Weapon Scoring System (AWSS) using 3D Mixed Reality <i>Andria Kusuma Wahyudi, Ardian Infantono</i>	346-350
64	Decision Making with AHP for Selection of Employee <i>Ria Eka Sari, Abdul Meizar, Dahriani Hakim Tanjung, Ahir Yugo Nugroho Harahap</i>	351-355
65	Applications of Artificial Intelligence to Identify Psychoanalysis Drug Addiction Patients and HIV / AIDS in Cognitive Science Modeling using Bayes Method <i>A. Hanifa Setianingrum, Bagus Sulistyo Budhi</i>	356-362
66	Application of Kalman Filter to Track Ship Maneuver <i>Amicytia Nadzilah, Danny M. Gandana, Jemie Muliadi, Yanto Daryanto</i>	363-367
67	Implementation of SDR for Video Transmission Using GNU Radio and USRP B200 <i>Octarina Nur Samijayani, Pramuditoruni Gitomojati, Dwi Astharini, Suci Rahmatia, Nurul Ihsan Hariz Pratama</i>	368-371
68	Strategic Planning For the Information Development of IPDC (Instituto Profissional De Canossa) Library Using TOGAF Method <i>Umbelina de Fatima Gusmao, Djoko Budiyanto Setyohadi</i>	372-377
69	A Fast and Accurate Detection of Schizont Plasmodium Falciparum Using Channel Color Space Segmentation Method <i>Edy Victor Haryanto S, M. Y. Mashor, A.S. Abdul Nasir, H. Jaafar</i>	378-381
70	Malaria Parasite Detection with Histogram Color Space Method in Giemsa-stained Blood Cell Images <i>Edy Victor Haryanto S, M. Y. Mashor, A.S. Abdul Nasir, H. Jaafar</i>	382-385

- 71 Automated Segmentation Procedure for Ziehl-Neelsen Stained Tissue Slide Images 386-390
Bob Subhan Riza, M. Y. Mashor, M. K. Osman, H. Jaafar
- 72 Information Security Evaluation using KAMI Index for Security Improvement in BMKG 391-394
D. I. Sensuse, M. Syarif, H Suprpto, R. Wirawan, D. Satria, Y Normandia
- 73 Classification of Maturity Level of Fuji Apple Fruit With Fuzzy Logic Method 395-398
Evi Dewi Sri Mulyani, Susanto, Jeni Poniman
- 74 Exploring the Organizational Factor Contributing to Effective IT Implementation 399-403
Muhamamd Qomarul Huda, Nur Aeni Hidayah, Meinarini Catur Utami
- 75 PeGI in Practice: The e-Government Assessment in National Library of Indonesia 404-409
Dana Indra Sensuse, Abrar Nasbey, Nordianto, Retno Dewiyanti, Rio Novira, M Fadhil Dzulfikar
- 76 Comparative Analysis of Business Process Litigation Using Queue Theory and Simulation (Case Study: Religious Courts South Jakarta) 410-416
Rizal Broer Bahaweres, Anida Fitriyah, Nurul Faizah Rozy
- 77 Design of E-Commerce Information Systems for Houseplants: the Case of Yasyifa Nursery Plantation 417-421
Ujang Maman, Yuni Sugiarti, Nia Kumaladewi
- 78 Development of CCRP Algorithm Based On Departure Time to Support Disaster Evacuation Scheduling 422-426
Ida Ayu Gde Suwiprabayanti Putra
- 79 Critical Success Factors of E-Government Implementation Based on Meta-Ethnography 427-432
Darmawan Napitupulu, Dana Indra Sensuse, Yudho Giri Sucahyo
- 80 Supply Chain Model for University Al Azhar Indonesia in the Field of Education 433-438
Syarif Hidayat, Cinthia Amalia Martayodha

81	IT Security Governance Evaluation with use of COBIT 5 Framework: A Case Study on UIN Syarif Hidayatullah Library Information System <i>Yusuf Durachman, Yuliza Chairunnisa, Djoko Soetarno, Agus Setiawan, Fitri Mintarsih</i>	439-443
82	Inventory Management Information System Development at BPRTIK Kemkominfo Jakarta <i>Elvi Fetrina, Eri Rustamaji, Tatat Nuraeni, Yusuf Durachman</i>	444-447
83	Hadith Degree Classification for Shahih Hadith Identification Web Based <i>Ina Najiyah, Sari Susanti, Dwiza Riana, Mochamad Wahyudi</i>	448-453
84	Mobile Tourism Application Using Augmented Reality <i>Riri Safitri, Deska Setiawan Yusra, Denny Hermawan, Endang Ripmiatin, Winangsari Pradani</i>	454-459
85	Pilgrimage Organizers Monitoring System To Improve Umrah Services (Case Study: Sub Directorate of Umrah Development of the Ministry of Religious Affairs of the Republic of Indonesia) <i>Nia Kumaladewi, Muhammad Anas, Suci Ratnawati, M. Qomarul Huda, Yusuf Durachman</i>	460-463
86	Spatial Data Management System for Spread of Diniyah Takmiliyah Awaliyah <i>Eva Khudzaeva, Zainul Arham, Sunarya</i>	464-468
87	Conceptual Approach for Gathering SPL Requirement from Goal Model <i>Imam Marzuki Shofi, Ahmad Nurul Fajar</i>	469-473
88	Improvement Accuracy of Oil Meal Packaging with Method ANP <i>Asbon Hendra Azhar, Ratih Adinda Destari, Linda Wahyuni, Fitriana Harahap</i>	474-479
89	A Comparison of Mamdani and Sugeno Method for Optimization Prediction of Traffic Noise Levels <i>Alfa Saleh, Fujiati, Rika Rosnelly, Khairani Puspita, Andi Sanjaya</i>	480-483
90	The Prototype of Zakat Management System in Indonesia by Using the Social Society Approach: A Case Study <i>Husni Teja Sukmana, Devi Lestiani, Nenny Anggraeni, Djoko Soetarno</i>	484-487

91	Embryos Sorting Efficiency Identification of Eggs with Algorithms Using Gabor Wavelet <i>Adil Setiawan, Rika Rosnelly, Soeheri, Ratna Sri Hayati, Rita Novita Sari</i>	488-493
92	Enterprise Architecture Modeling for Oriental University in Timor Leste to Support the Strategic Plan of Integrated Information System <i>Sergio Soares, Djoko Budiyanto Setyohadi</i>	494-499
93	Optimization of Multiple Depot Vehicle Routing Problem (MDVRP) on Perishable Product Distribution by Using Genetic Algorithm and Fuzzy Logic Controller (FLC) <i>Elin Haerani, Luh Kesuma Wardhani, Dian Kumala Putri, Husni Teja Sukmana</i>	500-504
94	Application for Determining Mustahiq Based on the Priority using Weight Product Method (Case Study: BAZIS DKI Jakarta) <i>Harry Okta Maulana, Imam M. Shofi, Nurul Faizah Rozy, Fenty Eka Muzayyana Agustin</i>	505-508
95	Segmentation of Crack Area on Road Image Using Lacunarity Method <i>I Putu Gede Abdi Sudiatmika</i>	509-514
96	Context for the Intelligent Search of Information <i>Syopiansyah Jaya Putra, Ismail Khalil</i>	515-518
97	Quality Dimensions of Delone & Mclean Model to Measure Students' Accounting Computer Satisfaction: An Empirical Test on Accounting System Information <i>Robi Aziz Zuama, Jamal Maulana Hudin, Diah Puspitasari, Eni Heni Hermaliani, Dwiza Riana</i>	519-524
98	Designing Dipole Antenna for TV Application and Rectangular Microstrip Antenna Working at 3 GHz for Radar Application <i>Suci Rahmatia, Enggar Fransiska DW, Nurul Ihsan Hariz Pratama, Putri Wulandari, Octarina Nur Samijayani</i>	525-530
99	Integration of Bagging and Greedy Forward Selection on Image Pap Smear Classification using Naïve Bayes <i>Dwiza Riana, Achmad Nizar Hidayanto, Fitriyani</i>	531-537
100	Indonesian Teacher Engagement Index (ITEI): Decision Support System for Education <i>Sasmoko, Andi Muhammad Muqsith, Danu Widhyatmoko, Yasinta Indrianti, Aqeel Khan</i>	538-542

101	Evaluating the Accessibility of Provinces' E-Government Websites in Indonesia	543-548
	<i>I Gusti Bagus Ngurah Eka Darmaputra, Sony Surya Wijaya, Media Anugerah Ayu</i>	
102	Development of a Retrieval System for Al Hadith in Bahasa (Case Study: Hadith Bukhari)	549-553
	<i>Atqia Aulia, Dewi Khairani, Nashrul Hakiem</i>	
	Author Index	554-559

A Multi-Study Program Recommender System Using ELECTRE Multicriteria Method

Linda Marlinda
STMIK Nusa Mandiri Jakarta
Jakarta, Indonesia
linda.ldm@nusamandiri.ac.id

Taufik Baidawi
AMIK BSI Sukabumi
Jakarta, Indonesia
taufiq.tfb@bsi.ac.id

Yusuf Durachman
Dept. Information System
State Islamic University (UIN)
Syarif Hidayatullah Jakarta, Indonesia
yusuf_durachman@uinjkt.ac.id

Akmaludin
STMIK Nusa Mandiri Jakarta
Jakarta, Indonesia
akmaludin.akm@nusamandiri.ac.id

Abstract - Selection of study program plays an important role in the success of a person to determine his future. One of the risks associated with the selection of study is the incompatibility with the needs of the current job vacancies in companies that significantly affect the future of these students. Since there are many criteria that must be considered, then through this recommender system, students are able to know what fields are the most appropriate for them. This system is built based on Electre method. When a student fills out a questionnaire, he must be consistent with his/her answer to obtain the best output based on his/her will and characteristics. This research uses descriptive analytical method and presents a summary of the results of surveys and interviews of 310 colleges in accordance with the codification which connect with Job Career so it can be a reference to prospective students in finding employment in the future company.

I. INTRODUCTION

Recommender systems that have been made previously are based on content-based filtering method and AHP. This technique matched item to a user profile or query-based content and not the opinion of other users. The system has some information about each item, recommendation can be given even if the system only receive a rating in small quantities, or even none at all. Each item must be described in accordance with the features that appear on the user's profile, and the profile of each user should be collected and modeled, firstly, seek representation documents. Second, create a profile that allows for documents that are not seen to be recommended. The weakness of the Recommender system based on content-based filtering and AHP is that very large number of questions amounted to 2700 questions must be filled by respondent and takes a long time in charging to generate the desired output[1].

To eliminate the weaknesses in Recommender system based on content-based filtering and AHP, researchers attempt to combine the ELECTRE technique. One of them is the study carried out by lindal et al [2]. They use a combination of

simple technique, which is generated from the prediction's ranking generated out of content-based prediction and prediction ELECTRE. The advantages of ELECTRE are used to reduce the impact of sparsity problem and early rater. ELECTRE technique is only useful when the system has received rating in a rather large amount, because few amount of the ratings data would complicate the system to make recommendations [3].

Recommendations from ELECTRE technique does not rely on user ratings. This technique does not need to gather information about a particular user because the assessment is not based on individual taste. Knowledge-based recommender system is a technique that uses the knowledge of the user and the product in building a knowledge-based approach to produce a recommendation. These characteristics make knowledge-based useful when implemented alone or as a complement of other types of recommender systems [4]. Si & Jin used a mixed model for filtering approach, which aims to group (clustering). The use of this method can evoke recommendation and make it easier in terms of selection decisions based on existing widely considerable variations [5].

Recommender systems are based on research with respondents who have difficulty in choosing varying courses opened by universities in the Kopertis III region, making it easier for users to choose the desired study program based on company needs at this time. Programs and academic studies in 300 universities in total located in the region Kopertis III Jakarta, with 200 varieties of courses that opened in the Kopertis III area out of the 500 courses opened throughout Indonesia[1].

II. THEORETICAL REVIEW

This section briefly explains about Recommender Systems, Electre, and MCDM, and also investigates some previous studies related to the implementation of the recommender systems. This section will also explains the methodology used in this study.

2.1. Recommender Systems

According to [3] a recommender system is a system which recommends a solution of explicit problems based on hierarchical structure. In the most general formulation, recommendation problems are reduced by rating to items which have not been recognized by a user.

A recommender system itself can be defined as a system which generates individual recommendation as an output, or it can also be defined as a system which helps user to find desired items by giving recommendation based on one of the recommended content items (content-based filtering) or similar user ratings on recommended items (collaborative filtering). In another area, for example, information filtering recommender system uses problems analysis techniques to help customers find products they want to buy by producing similarity of prediction score or a list of recommended products for specific customers [6].

The recommender system is also usually classified into the following categories:

- Content based recommendation (Content-based Filtering):
The user will be recommended items similar to the user preferred in the past.
- Collaborative recommendations (Collaborative Filtering):
The user will be recommended items similar to the user preference and interest in the past.
- Hybrid approach (hybrid collaboration):
These methods combine collaborative and content-based methods.

2.2 Multi Criteria Decision Making (MCDM)

Multi Criteria Decision Making (MCDM) is a decision-making technique based on several existing alternatives or a theory which explains about decision making process by considering many criteria. In order to model recommendation problems as MCDM, one must follow four general steps of modeling methodology to make a decision for the problem [4]:

- Decision object. It defines the object on which decisions must be made and the reasons of the decision recommendation.
- Family of criteria. Namely, it defines identification and modeling of a set of criteria that influence decision, and a complete and non-redundant recommendation.
- Global preference model. It defines aggregator function for marginal preference on each criterion to global preference from decision maker for every item.
- Decision support process. Namely, it defines study of various categories and types of recommender systems that can be used to support decision makers' recommendations, in accordance to the results of previous steps.

Implementation of the MCDM method in a recommender system has yet to be explored systematically. Recommender System is capable to explain some system contributions which involve several MCDM methods. This system has many domain applications. On the other hand, a comprehensive analysis will facilitate understanding and system development

that can identify dimension which distinguish, explain, and categorize multi-criteria system recommender, based on existing taxonomy and categorization that is used in the analysis and classification of online user decision sample[7].

MCDM is a theory of decision making that considers a limited set of alternative options against many criteria. The problem in MCDM can be formulated as follows:

Suppose there are M criteria and N alternatives. We must choose some or a set of alternatives which fulfill criteria as maximum as possible [9]. MCDM problem can be modeled in decision matrix.

TABLE 1:
Decision Matrix [7]

Alternative	Criteria				
	C_1 W_1	C_2 W_2	C_3 W_3	...	C_N W_N
A_1	a_{11}	a_{12}	a_{13}	...	a_{1N}
A_2	a_{21}	a_{22}	a_{23}	...	a_{2N}
A_3	a_{31}	a_{32}	a_{33}	...	a_{3N}
.
.
.
A_M	a_{M1}	a_{M2}	a_{M3}	...	a_{MN}

Decision matrix is a matrix of size M x N where the element a_{ij} indicates the performance of alternative A_i when evaluated against the criteria C_j (for $i = 1, 2, 3, \dots, M$ and $j = 1, 2, 3, \dots, N$). [4]

MCDM methods using the Analytic Hierarchy Process (AHP), can convert ordinal scale to ratio scale and even check the consistency[12].

2.3 ELECTRE (Elimination Et Choix Traduisant La Réalité) Method

ELECTRE (Elimination Et Choix Traduisant La Réalité) is a system that uses ELECTRE method which is a method of multicriteria decision-making based on the concept of outranking using pairwise comparison of alternatives based on any criteria appropriate [8].

The steps are as follows:

- Normalized decision matrix. Each attribute is changed to a comparable value.
- Weighted normalized matrix. Once normalized, each column of the matrix R multiplied by the weight of the weight (w) determined by the decision maker.
- Determine the set of concordance and discordance index. For each pair of alternatives k and l ($k, l = 1, 2, 3, \dots, m$ and $k \neq l$) a set of criteria is divided into two subsets, namely concordance and discordance.
- Calculate the matrix of concordance and discordance. Calculate the concordance matrix to determine the value of the elements in the concordance matrix by adding weights included in the mathematical concordance set. Determine the value of the elements in the discordance matrix by

dividing the maximum difference of criteria included into discordance subsets with a maximum difference of the value of all the existing criteria.

- e. Determine the dominant matrix of concordance and discordance. Matrix F as dominant concordance matrix can be constructed with the aid of a threshold value, by comparing the value of each concordance matrix element with the threshold value. Calculate the dominant discordance matrix. The matrix G as the dominant discordance matrix can be built with the help of the threshold value.
- f. Determine the aggregate dominance matrix. The matrix E as aggregate dominance matrix is a matrix in which each element is the multiplication between the elements of F matrix to the corresponding elements of matrix G.
- g. Elimination of the less favorable alternative. The matrix E gives the preferred order of each alternative, that is, if the alternative is a better alternative than A_i. Thus, the line in the matrix E which has the least number can be eliminated. Thus, the best alternative is an alternative that dominates other alternatives.

Application of MCDA in the Election of Study Program

The study began with the observation and implementation of the selection study program recommender system to minimize errors that would result from the failure of electing study program in this study prior to its numbering of 2700 questions to prospective new students. The data was processed using a descriptive analytic method to present a summary of the results of the questionnaire survey and interviews done manually and online. Survey of private colleges in the Kopertis III region was done to find which courses are open in every university. There were 310 universities in accordance with codifying universities in Kopertis III, with 200 courses opened. The author also came to Career Job-seeking courses to find any information needed by companies today [1].

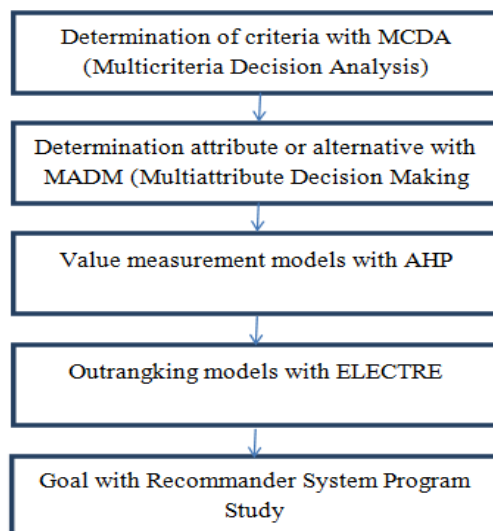


Fig. 2 Steps Conducted in the Study

III. IMPLEMENTATION AND RESULTS

Analysis of the application of multi-criteria recommender system study selection program using ELECTRE generates a result of execution that can be expected to make a recommendation for prospective new students by classifying criteria, sub-criteria and alternatives to the existing questionnaires. The process of filling out the questionnaire by the respondents should be consistent in order to produce the expected output.

ERD (Entity Relationship Diagram)

ERD is a model of a relational database based on the perception in the real world; the world is always composed of a set of objects that interact with each other. An object is called entity and relationships of its so-called relationship. An entity is unique and has the attribute as a differentiator with other entities. [10]

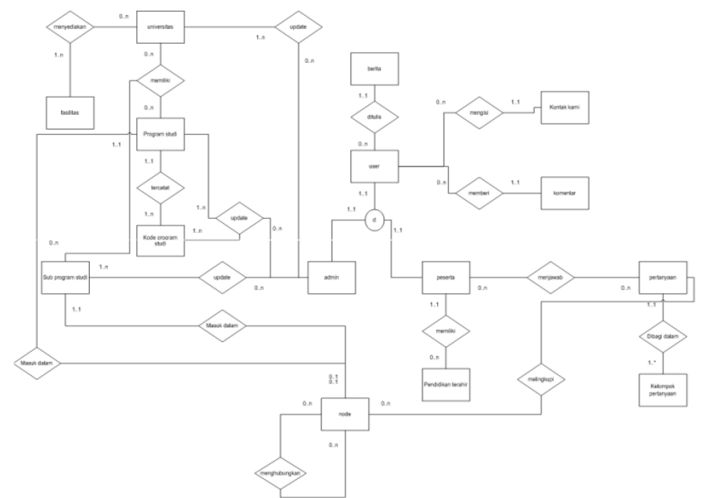


Fig. 3 ERD of Study Program Recommender System [1]

Calculations using ELECTRE methods as follows:

Alternative	Criteria				
	Expense	Career	Reputation	Study programs	Sub-programs Study
Health	5	5	3	3	3
Technique	3	3	4	2	3
Computer	4	5	1	3	2

Decision-making giving preference weights as:

$W = (5, 4, 3, 3, 1)$

The decision matrix formed from the following table:

$$\begin{bmatrix} 5 & 5 & 3 & 3 & 3 \\ 3 & 3 & 4 & 2 & 3 \\ 4 & 5 & 1 & 3 & 2 \end{bmatrix}$$

To solve the above problem with the method ELECTRE will be done with the steps described earlier:

1. Normalized decision matrix:

$$\begin{bmatrix} 0,707 & 0,650 & 0,696 & 0,639 & 0,639 \\ 0,424 & 0,390 & 0,696 & 0,426 & 0,639 \\ 0,565 & 0,650 & 0,174 & 0,639 & 0,426 \end{bmatrix}$$

2. Weighted normalized matrix

$$\begin{bmatrix} 3,536 & 2,604 & 2,089 & 1,919 & 0,640 \\ 2,121 & 1,562 & 2,089 & 1,279 & 0,640 \\ 2,828 & 2,604 & 0,522 & 1,919 & 0,426 \end{bmatrix}$$

3. Determine the set of concordance index.

- a. Concordance. A criteria in an alternative if:

$$c_{ki} = \{j, v_{kj} \geq v_{ij}\}, \text{ untuk } j = 1, 2, 3, \dots, n$$

The result:

Concordance	Health	Technique	Computer
Health	-	2, 4	1, 2, 3, 4, 5
-	1, 2, 4		4, 5
Computer	1, 2	1, 2, 3	-

- b. Discordance. A criteria in an alternative if:

$$D_{ki} = \{j, v_{kj} \geq v_{ij}\}, \text{ untuk } j = 1, 2, 3, \dots, n$$

The result:

Discordance	Health	Technique	Computer
Health	-	1, 5	-
Technique	1, 3, 5	-	1, 2
Computer	3, 4, 5	4, 5	-

4. Calculate the matrix of concordance and discordance

$$c_{ki} = \sum_{j \in c_{ki}} w_j$$

$$c_{12} = w_2 + w_4 = 4 + 3 = 7$$

$$c_{13} = w_1 + w_2 + w_3 + w_4 + w_5 = 5 + 4 + 3 + 3 + 1 = 16$$

$$c_{21} = w_1 + w_2 + w_4 = 5 + 4 + 3 = 12$$

$$c_{23} = w_4 + w_5 = 3 + 1 = 4$$

$$c_{31} = w_1 + w_2 = 5 + 4 = 9$$

$$c_{32} = w_1 + w_2 + w_3 = 5 + 4 + 3 = 12$$

The result:

$$\begin{bmatrix} - & 7 & 16 \\ 12 & - & 4 \\ 9 & 12 & - \end{bmatrix}$$

Calculate the matrix of concordance

$$d_{ki} = \frac{\max \{|v_{kj} - v_{ij}|\} j \in D_{ki}}{\max \{|v_{kj} - v_{ij}|\} \forall j}$$

Calculations:

$$d_{12} = \frac{\max \{|v_{1j} - v_{2j}|\} j \in D_{12}}{\max \{|v_{1j} - v_{2j}|\} \forall j}$$

$$= \frac{\max \{|3,535 - 2,121|; |0,639 - 0,639|\}}{\max \{|3,535 - 2,121|; |2,603 - 1,562|; |2,785 - 2,785|; |1,918 - 1,279|; |0,639 - 0,639|\}} = 1$$

$$d_{13} = \frac{\max \{|v_{1j} - v_{3j}|\} j \in D_{13}}{\max \{|v_{1j} - v_{3j}|\} \forall j}$$

$$= \frac{\max (0)}{\max \{|3,535 - 2,121|; |2,603 - 1,562|; |2,785 - 2,785|; |1,918 - 1,279|; |0,639 - 0,639|\}} = 0$$

$$d_{21} = \frac{\max \{|v_{2j} - v_{1j}|\} j \in D_{21}}{\max \{|v_{2j} - v_{1j}|\} \forall j}$$

$$= \frac{\max \{|2,121 - 3,535|; |1,562 - 2,603|; |2,785 - 2,785|\}}{\max \{|3,535 - 2,121|; |2,603 - 1,562|; |2,785 - 2,785|; |1,918 - 1,279|; |0,639 - 0,639|\}} = 1$$

$$d_{31} = \frac{\max \{|v_{3j} - v_{1j}|\} j \in D_{31}}{\max \{|v_{3j} - v_{1j}|\} \forall j}$$

$$= \frac{\max \{|0,696 - 2,785|; |1,918 - 1,918|; |0,426 - 0,639|\}}{\max \{|3,535 - 2,121|; |2,603 - 1,562|; |2,785 - 2,785|; |1,918 - 1,279|; |0,639 - 0,639|\}} = 1$$

$$d_{32} = \frac{\max \{|v_{3j} - v_{2j}|\} j \in D_{32}}{\max \{|v_{3j} - v_{2j}|\} \forall j}$$

$$= \frac{\max \{|1,918 - 1,918|; |0,426 - 0,639|\}}{\max \{|3,535 - 2,121|; |2,603 - 1,562|; |2,088 - 2,088|; |1,918 - 1,279|; |0,639 - 0,639|\}} = 0,408$$

$$d_{23} = \frac{\max \{|v_{2j} - v_{3j}|\} j \in D_{23}}{\max \{|v_{2j} - v_{3j}|\} \forall j}$$

$$= \frac{\max \{|2,121 - 2,828|; |1,562 - 2,603|\}}{\max \{|3,535 - 2,121|; |2,603 - 1,562|; |2,088 - 2,088|; |1,918 - 1,279|; |0,639 - 0,639|\}} = 0,665$$

The result:

$$\begin{bmatrix} - & 1 & 0 \\ 1 & - & 0,665 \\ 0 & 0,408 & - \end{bmatrix}$$

5. Determine the dominant matrix of concordance and discordance

- a. Calculating the dominant matrix concordance

$$c = \frac{\sum_{k=1}^m \sum_{l=1}^m C_{kl}}{m(m-1)}$$

$$= \frac{7 + 16 + 12 + 4 + 9 + 12}{3(3-1)} = 10$$

The Matrix:

$$\begin{bmatrix} - & 0 & 1 \\ 1 & - & 0 \\ 0 & 1 & - \end{bmatrix}$$

- b. Calculating matrix of discordance:

$$d = \frac{\sum_{k=1}^m \sum_{l=1}^m C_{kl}}{m(m-1)}$$

$$= \frac{1 + 1 + 0,665 + 1 + 0,408}{3(3-1)} = 0,679$$

The Matrix:

$$\begin{bmatrix} - & 1 & 0 \\ 1 & - & 0 \\ 1 & 0 & - \end{bmatrix}$$

6. Determine the aggregate dominance matrix:

$$e_{ki} = f_{ki} \times g_{ki}$$

The Matrix:

$$\begin{bmatrix} - & 0 & 0 \\ 1 & - & 0 \\ 0 & 0 & - \end{bmatrix}$$

IV. CONCLUSION

A multi-criteria recommendation system with AHP and Electre has been developed to support prospective students or secondary school graduates in choosing courses. Multi-criteria decision-making applied in the system solves complex problems, and is able to handle the interdependence of elements in the system and not impose linear thinking. This electre method can intelligently generate decisions quickly once the respondents fill in the field of study, which is not possible by using a manual application (ie expert choice) where respondents can not get the results in real time. The results of the calculation can be used as a recommendation for prospective students to determine the choice of courses that will be the future goal. Excess Electre method can provide the best alternative decision solution in decision making with many criteria. Based on the calculation, the choice of

technology has a threshold value of concordance dominant matrix of 10 and the threshold value of dominant matrix diconcordance 0.679.

REFERENCES

- [1] Marlinda, Linda., et al, "A Multi Study Program Recommender System Using Content-Based Filtering and Analytical Hierarchy process (AHP) Methods", IJCSI International journal Of Computer Science Issue 3. No 2, May 2012. ISSN (Online): 1694-0814.
- [2] Marlinda, Linda., "Sistem Pendukung Keputusan Pemilihan Tempat Wisata Yogyakarta Menggunakan Metode Elimination Et Choix Traduisant La Realita (ELECTRE) ", Prosiding Semnastek 2016. P-ISSN 2407-1846, E-ISSN 2460-8416
- [3] Adomavicius, G., et al. "Toward the Next Generation of Recommender Systems: A Survey of the State of the Art and Possible Extensions", 2005, IEEE Transactions on Knowledge and Data Engineering.
- [4] Manouselis, N., et al, "Analysis and Classification of Multi-Criteria Recommender System". World Wide Web: Internet and Web Information Systems, Special Issue on Multi-channel Adaptive Information System on the World Wide Web. 2007, Springerlink
- [5] Montainer, M., et al, "A Taxonomy of Recommender Agents on the Internet. Artificial Intelligence", Kluwer Academic Publisher. Netherlands, 2003, Review 19: 285-330.
- [6] Burke, R. "Hybrid Recommender Systems: Survey and Experiments". User Adapt. Inter, 2003, Vol. 12 pp. 331-370
- [7] Ziller, Annette, Michaela Wörndl, and Andrea Bichler, 2008, Multi_criteria_decision_making_Ju ne_2008_
- [8] Janko, Wolfgang dan Bernroider, Edward, " Multi-Criteria Decision Making An Application Study of ELECTRE & TOPSIS". 2005.
- [9] Fulop, J. "Introduction to Decision Making Methods", Laboratory of Operations Research and Decision Systems, Computer and Automation Institute, Hungarian Academy of Sciences, 2007.
- [10] Marlinda. "Sistem Basis Data". Andi Offset Yogyakarta, Indonesia, 2004.
- [11] Triantaphyllou, E., et al. "A Computational Evaluation of The Original and Revised Analytic Hierarchy Process", Computer ind. Engng Vol. 26, No.3, pp.609-618. Elsevier Science Ltd, 1994.
- [12] Montainer, M., et al, "A Taxonomy of Recommender Agents on the Internet. Artificial Intelligence", Kluwer Academic Publisher. Netherlands, Review 19: 285-330, 2003.

A Multi-Study Program Recommender System Using ELECTRE Multicriteria Method

by Linda Marlinda

Submission date: 03-Feb-2020 05:23PM (UTC+0000)

Submission ID: 1250808304

File name: marlinda2017.docx (115.14K)

Word count: 2513

Character count: 13895

A Multi-Study Program Recommender System Using ELECTRE Multicriteria Method

2

Linda Marlinda
STMIK Nusa Mandiri Jakarta
Jakarta, Indonesia
linda.ldm@nusamandiri.ac.id

Taufik Baidawi
AMIK BSI Sukabumi
Jakarta, Indonesia
taufiq.tfb@bsi.ac.id

Yusuf Durachman

16 Dept. Information System
State Islamic University (UIN)
Syarif Hidayatullah Jakarta, Indonesia
yusuf_durachman@uinjkt.ac.id

2

Akmaludin
STMIK Nusa Mandiri Jakarta
Jakarta, Indonesia
akmaludin.akm@nusamandiri.ac.id

8

Abstract - Selection of study program plays an important role in the success of a person to determine his future. One of the risks associated with the selection of study is the incompatibility with the needs of the current job vacancies in companies that significantly affect the future of these students. Since there are many criteria that must be considered, then through this recommender system, students are able to know what fields are the most appropriate for them. This system is built based on Electre method. When a student fills out a questionnaire, he must be consistent with his/her answer to obtain the best output based on his/her will and characteristics. This research uses descriptive analytical method and presents a summary of the results of surveys and interviews of 310 colleges in accordance with the codification which connect with Job Career so it can be a reference to prospective students in finding employment in the future company.

I. INTRODUCTION

Recommender systems that have been made previously are based on content-based filtering method and AHP. This technique matched item to a user profile query-based content and not the opinion of other users. The system has some information about each item, recommendation can be given even if the system only receive a rating in small quantities, or even none at all. Each item must be described in accordance with the features that appear on the user's profile, and the profile of each user should be collected and modeled, firstly, seek representation documents. Second, create a profile that allows for documents that are not seen to be recommended. The weakness of the Recommender system based on content-based filtering and AHP is that very large number of questions amounted to 2700 questions must be filled by respondent and takes a long time in charging to generate the desired output [1].

To eliminate the weaknesses in Recommender system based on content-based filtering and AHP, researchers attempt to combine the ELECTRE technique. One of them is the study carried out by lindal et al [2]. They use a combination of

simple technique, which is generated from the prediction's ranking generated out of content-based prediction and prediction ELECTRE. The advantages of ELECTRE are used to reduce the impact of sparsity problem and early rater. ELECTRE technique is only useful when the system has received rating in a rather large amount, because few amount of the ratings data would complicate the system to make recommendations [3].

Recommendations from ELECTRE technique does not rely on user ratings. This technique does not need to gather information about a particular user because the assessment is not based on individual taste. Knowledge-based recommender system is a technique that uses the knowledge of the user and the product in building a knowledge-based approach to produce a recommendation. These characteristics make knowledge-based useful when implemented alone or as a complement of other types of recommender systems [4]. Si & Jin used a mixed model for filtering approach, which aims to group (clustering). The use of this method can evoke recommendation and make it easier in terms of selection decisions based on existing widely considerable variations [5]. Recommender systems are based on research with respondents who have difficulty in choosing varying courses opened by universities in the Kopertis III region, making it easier for users to choose the desired study program based on company needs at this time. Programs and academic studies in 300 universities in total located in the region Kopertis III Jakarta, with 200 varieties of courses that opened in the Kopertis III area out of the 500 courses opened throughout Indonesia [1].

II. THEORETICAL REVIEW

This section briefly explains about Recommender Systems, Electre, and MCDM, and also investigates some previous studies related to the implementation of the recommender systems. This section will also explains the methodology used in this study.

2.1. Recommender Systems

According to [3] a recommender system is a system which recommends a solution of explicit problems based on hierarchical structure. In the most general formulation, recommendation problems are reduced by rating to items which have not been recognized by a user.

A recommender system itself can be defined as a system which generates individual recommendation as an output, or it can also be defined as a system which helps user to find desired items by giving recommendation based on one of the recommended content items (content-based filtering) or similar user ratings on recommended items (collaborative filtering). In another area, for example, information filtering recommender system uses problems analysis techniques to help customers find products they want to buy by producing similarity of prediction score or a list of recommended products for specific customers [6].

The recommender system is also usually classified into the following categories:

- Content based recommendation (Content-based Filtering):**
The user will be recommended items similar to the user preferred in the past.
- Collaborative recommendations (Collaborative Filtering):**
The user will be recommended items similar to the user preference and interest in the past.
- Hybrid approach (hybrid collaboration):**
These methods combine collaborative and content-based methods.

2.2. Multi Criteria Decision Making (MCDM)

Multi Criteria Decision Making (MCDM) is a decision-making technique based on several existing alternatives or a theory which explains about decision making process by considering many criteria. In order to model recommendation problems as MCDM, one must follow four general steps of modeling methodology to make a decision for the problem [4]:

- Decision object.** It defines the object on which decisions must be made and the reasons of the decision recommendation.
- Family of criteria.** Namely, it defines identification and modeling of a set of criteria that influence decision, and a complete and non-redundant recommendation.
- Global preference model.** It defines aggregator function for marginal preference on each criterion to global preference from decision maker for every item.
- Decision support process.** Namely, it defines study of various categories and types of recommender systems that can be used to support decision makers' recommendations, in accordance to the results of previous steps.

Implementation of the MCDM method in a recommender system has yet to be explored systematically. Recommender System is capable to explain some system contributions which involve several MCDM methods. This system has many domain applications. On the other hand, a comprehensive analysis will facilitate understanding and system development

that can identify dimension which distinguish, explain, and categorize multi-criteria system recommender, based on existing taxonomy and categorization that is used in the analysis and classification of online user decision sample [7].

MCDM is a theory of decision making that considers a limited set of alternative options against many criteria. The problem in MCDM can be formulated as follows:

Suppose there are M criteria and N alternatives. We must choose some or a set of alternatives which fulfill criteria as maximum as possible [9]. MCDM problem can be modeled in decision matrix.

TABLE 1:
Decision Matrix [7]

Alternative	Criteria				
	C_1 W_1	C_2 W_2	C_3 W_3	...	C_N W_N
A_1	a_{11}	a_{12}	a_{13}	...	a_{1N}
A_2	a_{21}	a_{22}	a_{23}	...	a_{2N}
A_3	a_{31}	a_{32}	a_{33}	...	a_{3N}
.
.
.
A_M	A_{M1}	A_{M2}	A_{M3}	...	a_{MN}

Decision matrix is a matrix of size M x N where the element a_{ij} indicates the performance of alternative A_i when evaluated against the criteria C_j (for $i = 1, 2, 3, \dots, M$ and $j = 1, 2, 3, \dots, N$). [4]

MCDM methods using the Analytic Hierarchy Process (AHP), can convert ordinal scale to ratio scale and even check the consistency [12].

2.3 ELECTRE (Elimination Et Choix Traduisant La Réalité) Method

ELECTRE (Elimination Et Choix Traduisant La Réalité) is a system that uses ELECTRE method which is a method of multicriteria decision-making based on the concept of outranking using pairwise comparison of alternatives based on any criteria appropriate [8].

The steps are as follows:

- Normalized decision matrix.** Each attribute is changed to a comparable value.
- Weighted normalized matrix.** Once normalized, each column of the matrix R multiplied by the weight of the weight (w) determined by the decision maker.
- Determine the set of concordance and discordance index.** For each pair of alternatives k and l ($k, l = 1, 2, 3, \dots, m$ and $k \neq l$) a set of criteria is divided into two subsets, namely concordance and discordance.
- Calculate the matrix of concordance and discordance.** Calculate the concordance matrix to determine the value of the elements in the concordance matrix by adding weights included in the mathematical concordance set. Determine the value of the elements in the discordance matrix by

dividing the maximum difference of criteria included into discordance subsets with a maximum difference of the value of all the existing criteria.

- e. Determine the dominant matrix of concordance and discordance. Matrix F as dominant concordance matrix can be constructed with the aid of a threshold value, by comparing the value of each concordance matrix element with the threshold value. Calculate the dominant discordance matrix. The matrix G as the dominant discordance matrix can be built with the help of the threshold value.
- f. Determine the aggregate dominance matrix. The matrix E as aggregate dominance matrix is a matrix in which each element is the multiplication between the elements of F matrix to the corresponding elements of matrix G.
- g. Elimination of the less favorable alternative. The matrix E gives the preferred order of each alternative, that is, if the alternative is a better alternative than A1. Thus, the line in the matrix E which has the least number can be eliminated. Thus, the best alternative is an alternative that dominates other alternatives.

Application of MCDA in the Election of Study Program

The study began with the observation and implementation of the selection study program recommender system to minimize errors that would result from the failure of electing study program in this study prior to its numbering of 2700 questions to prospective new students. The data was processed using a descriptive analytic method to present a summary of the results of the questionnaire survey and interviews done manually and online. Survey of private colleges in the Kopertis III region was done to find which courses are open in every university. There were 310 universities in accordance with codifying universities in Kopertis III, with 200 courses opened. The author also came to Career Job-seeking courses to find any information needed by companies today [1].

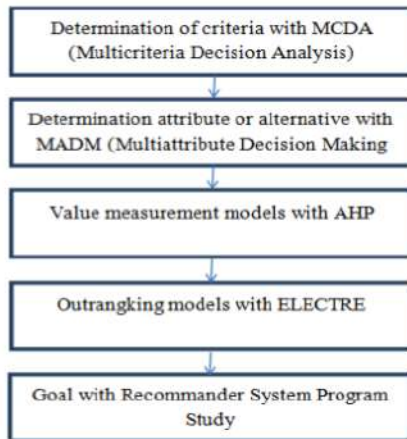


Fig. 2 Steps Conducted in the Study

III. IMPLEMENTATION AND RESULTS

Analysis of the application of multi-criteria recommender system study selection program using ELECTRE generates a result of execution that can be expected to make a recommendation for prospective new students by classifying criteria, sub-criteria and alternatives to the existing questionnaires. The process of filling out the questionnaire by the respondents should be consistent in order to produce the expected output.

ERD (Entity Relationship Diagram)

ERD is a model of a relational database based on the perception in the real world; the world is always composed of a set of objects that interact with each other. An object is called entity and relationships of its so-called relationship. An entity is unique and has the attribute as a differentiator with other entities. [10]

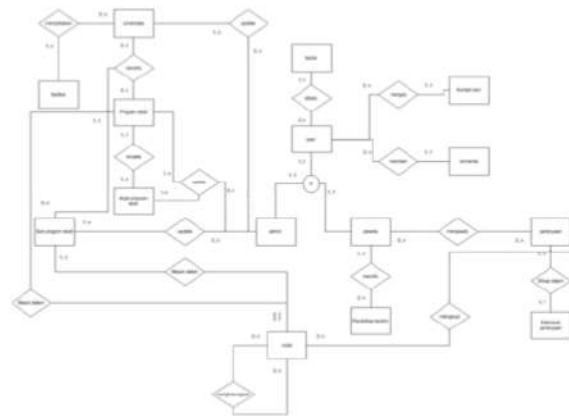


Fig. 3 ERD of Study Program Recommender System[1]

Calculations using ELECTRE methods as follows:

Alternative	Criteria				
	Expense	Career	Reputation	Study programs	Sub-programs Study
Health	5	5	3	3	3
Technique	3	3	4	2	3
Computer	4	5	1	3	2

Decision-making giving preference weights as:

$$W = (5, 4, 3, 3, 1)$$

The decision matrix formed from the following table:

$$\begin{bmatrix} 5 & 5 & 3 & 3 & 3 \\ 3 & 3 & 4 & 2 & 3 \\ 4 & 5 & 1 & 3 & 2 \end{bmatrix}$$

To solve the above problem with the method ELECTRE will be done with the steps described earlier:

1. Normalized decision matrix:

$$\begin{bmatrix} 0,707 & 0,650 & 0,696 & 0,639 & 0,639 \\ 0,424 & 0,390 & 0,696 & 0,426 & 0,639 \\ 0,565 & 0,650 & 0,174 & 0,639 & 0,426 \end{bmatrix}$$

2. Weighted normalized matrix

$$\begin{bmatrix} 3,536 & 2,604 & 2,089 & 1,919 & 0,640 \\ 2,121 & 1,562 & 2,089 & 1,279 & 0,640 \\ 2,828 & 2,604 & 0,522 & 1,919 & 0,426 \end{bmatrix}$$

3. Determine the set of concordance index.

- a. Concordance. A criteria in an alternative if:

$$c_{ki} = \{j, v_{kj} \geq v_{ij}\}, \text{ untuk } j = 1, 2, 3, \dots, n$$

The result:

Concordance	Health	Technique	Computer
Health	-	2, 4	1, 2, 3, 4, 5
-	1, 2, 4		4, 5
Computer	1, 2	1, 2, 3	-

- b. Discordance. A criteria in an alternative if:

$$D_{ki} = \{j, v_{kj} \geq v_{ij}\}, \text{ untuk } j = 1, 2, 3, \dots, n$$

The result:

Discordance	Health	Technique	Computer
Health	-	1, 5	-
Technique	1, 3, 5	-	1, 2
Computer	3, 4, 5	4, 5	-

4. Calculate the matrix of concordance and discordance

$$c_{ki} = \sum_{j \in c_{ki}} w_j$$

$$c_{12} = w_2 + w_4 = 4 + 3 = 7$$

$$c_{13} = w_1 + w_2 + w_3 + w_4 + w_5 = 5 + 4 + 3 + 3 + 1 = 16$$

$$c_{21} = w_1 + w_2 + w_4 = 5 + 4 + 3 = 12$$

$$c_{23} = w_4 + w_5 = 3 + 1 = 4$$

$$c_{31} = w_1 + w_2 = 5 + 4 = 9$$

$$c_{32} = w_1 + w_2 + w_3 = 5 + 4 + 3 = 12$$

The result:

$$\begin{bmatrix} - & 7 & 16 \\ 12 & - & 4 \\ 9 & 12 & - \end{bmatrix}$$

Calculate the matrix of concordance

$$d_{ki} = \frac{\max \{ |v_{kj} - v_{ij}| \}_{j \in D_{ki}}}{\max \{ |v_{kj} - v_{ij}| \}_{\forall j}}$$

Calculations:

$$d_{12} = \frac{\max \{ |v_{1j} - v_{2j}| \}_{j \in D_{12}}}{\max \{ |v_{1j} - v_{2j}| \}_{\forall j}}$$

$$= \frac{\max \{ |3,535 - 2,121|; |0,639 - 0,639| \}}{\max \{ |3,535 - 2,121|; |2,603 - 1,562|; |2,785 - 2,785|; |1,918 - 1,279|; |0,639 - 0,639| \}} = 1$$

$$d_{13} = \frac{\max \{ |v_{1j} - v_{3j}| \}_{j \in D_{13}}}{\max \{ |v_{1j} - v_{3j}| \}_{\forall j}}$$

$$= \frac{\max \{ 0 \}}{\max \{ |3,535 - 2,121|; |2,603 - 1,562|; |2,785 - 2,785|; |1,918 - 1,279|; |0,639 - 0,639| \}} = 0$$

$$d_{21} = \frac{\max \{ |v_{2j} - v_{1j}| \}_{j \in D_{21}}}{\max \{ |v_{2j} - v_{1j}| \}_{\forall j}}$$

$$= \frac{\max \{ |2,121 - 3,535|; |1,562 - 2,603|; |2,785 - 2,785| \}}{\max \{ |3,535 - 2,121|; |2,603 - 1,562|; |2,785 - 2,785|; |1,918 - 1,279|; |0,639 - 0,639| \}} = 1$$

$$d_{31} = \frac{\max \{ |v_{3j} - v_{1j}| \}_{j \in D_{31}}}{\max \{ |v_{3j} - v_{1j}| \}_{\forall j}}$$

$$= \frac{\max \{ |0,696 - 2,785|; |1,918 - 1,918|; |0,426 - 0,639| \}}{\max \{ |3,535 - 2,121|; |2,603 - 1,562|; |2,785 - 2,785|; |1,918 - 1,279|; |0,639 - 0,639| \}} = 1$$

$$d_{32} = \frac{\max \{ |v_{3j} - v_{2j}| \}_{j \in D_{32}}}{\max \{ |v_{3j} - v_{2j}| \}_{\forall j}}$$

$$= \frac{\max \{ |1,918 - 1,918|; |0,426 - 0,639| \}}{\max \{ |3,535 - 2,121|; |2,603 - 1,562|; |2,088 - 2,088|; |1,918 - 1,279|; |0,639 - 0,639| \}} = 0,408$$

$$d_{23} = \frac{\max \{ |v_{2j} - v_{3j}| \}_{j \in D_{23}}}{\max \{ |v_{2j} - v_{3j}| \}_{\forall j}}$$

$$= \frac{\max \{ |2,121 - 2,828|; |1,562 - 2,603| \}}{\max \{ |3,535 - 2,121|; |2,603 - 1,562|; |2,088 - 2,088|; |1,918 - 1,279|; |0,639 - 0,639| \}} = 0,665$$

The result:

$$\begin{bmatrix} - & 1 & 0 \\ 1 & - & 0,665 \\ 0 & 0,408 & - \end{bmatrix}$$

5. Determine the dominant matrix of concordance and discordance

- a. Calculating the dominant matrix concordance

$$c = \frac{\sum_{k=1}^m \sum_{i=1}^m C_{ki}}{m(m-1)}$$

$$= \frac{7 + 16 + 12 + 4 + 9 + 12}{3(3-1)} = 10$$

The Matrix:

$$\begin{bmatrix} - & 0 & 1 \\ 1 & - & 0 \\ 0 & 1 & - \end{bmatrix}$$

- b. Calculating matrix of discordance:

$$d = \frac{\sum_{k=1}^m \sum_{i=1}^m C_{ki}}{m(m-1)}$$

$$= \frac{1 + 1 + 0,665 + 1 + 0,408}{3(3-1)} = 0,679$$

The Matrix:

$$\begin{bmatrix} - & 1 & 0 \\ 1 & - & 0 \\ 1 & 0 & - \end{bmatrix}$$

6. Determine the aggregate dominance matrix:

$$e_{ki} = f_{ki} \times g_{ki}$$

The Matrix:

$$\begin{bmatrix} - & 0 & 0 \\ 1 & - & 0 \\ 0 & 0 & - \end{bmatrix}$$

IV. CONCLUSION

A multi-criteria recommendation system with AHP and Electre has been developed to support prospective students or secondary school graduates in choosing courses. Multi-criteria decision-making applied in the system solves complex problems, and is able to handle the interdependence of elements in the system and not impose linear thinking. This electre method can intelligently generate decisions quickly once the respondents fill in the field of study, which is not possible by using a manual application (ie expert choice) where respondents can not get the results in real time. The results of the calculation can be used as a recommendation for prospective students to determine the choice of courses that will be the future goal. Excess Electre method can provide the best alternative decision solution in decision making with many criteria. Based on the calculation, the choice of

technology has a threshold value of concordance dominant matrix of 10 and the threshold value of dominant matrix discordance 0.679.

REFERENCES

- [1] Marlinda, Linda., et al, "A Multi Study Program Recommender System Using Content-Based Filtering and Analytical Hierarchy process (AHP) Methods", IJCSI International journal Of Computer Science Issue 3, No 2, May 2012. ISSN (Online): 1694-0814.
- [2] Marlinda, Linda., "Sistem Pendukung Keputusan Pemilihan Tempat Wisata Yogyakarta Menggunakan Metode Elimination Et Choix Traduisant La Realita (ELECTRE) ", Prosiding Semnastek 2016. P-ISSN 2407-1846, E-ISSN 2460-8416
- [3] Adomavicius, G., et al. "Toward the Next Generation of Recommender Systems: A Survey of the State of the Art and Possible Extensions", 2005, IEEE Transactions on Knowledge and Data Engineering.
- [4] Manouselis, N., et al, "Analysis and Classification of Multi-Criteria Recommender System". World Wide Web: Internet and Web Information Systems, Special Issue on Multi-channel Adaptive Information System on the World Wide Web. 2007, Springerlink
- [5] Montainer, M., et al, "A Taxonomy of Recommender Agents on the Internet. Artificial Intelligence", Kluwer Academic Publisher. Netherlands, 2003, Review 19: 285-330.
- [6] Burke, R. "Hybrid Recommender Systems: Survey and Experiments". User Adapt. Inter, 2003, Vol. 12 pp. 331-370
- [7] Ziller, Annette, Michaela Wörndl, and Andrea Bichler, 2008, Multi_criteria_decision_making_June_2008_
- [8] Janko, Wolfgang dan Bernroider, Edward, " Multi-Criteria Decision Making An Application Study of ELECTRE & TOPSIS". 2005.
- [9] Fulop, J. "Introduction to Decision Making Methods". Laboratory of Operations Research and Decision Systems, Computer and Automation Institute, Hungarian Academy of Sciences, 2007.
- [10] Marlinda. "Sistem Basis Data". Andi Offset Yogyakarta, Indonesia, 2004.
- [11] Triantaphyllou, E., et al. "A Computational Evaluation of The Original and Revised Analytic Hierarchy Process", Computer ind. Engng Vol. 26, No.3, pp.609-618. Elsevier Science Ltd, 1994.
- [12] Montainer, M., et al, "A Taxonomy of Recommender Agents on the Internet. Artificial Intelligence", Kluwer Academic Publisher. Netherlands, Review 19: 285-330, 2003.

A Multi-Study Program Recommender System Using ELECTRE Multicriteria Method

ORIGINALITY REPORT

13%

SIMILARITY INDEX

4%

INTERNET SOURCES

8%

PUBLICATIONS

9%

STUDENT PAPERS

PRIMARY SOURCES

1

www.aaai.org

Internet Source

2%

2

Submitted to UIN Syarif Hidayatullah Jakarta

Student Paper

2%

3

Desi Ratna Sari, Nurul Rofiqo, Dedy Hartama, Agus Perdana Windarto, Anjar Wanto. "Analysis of the Factors Causing Lazy Students to Study Using the ELECTRE II Algorithm", Journal of Physics: Conference Series, 2019

Publication

1%

4

jhealthscope.com

Internet Source

1%

5

Putrama Alkhairi, Ledis Pebriani Purba, Anggy Eryzha, Agus Perdana Windarto, Anjar Wanto. "The Analysis of the ELECTREE II Algorithm in Determining the Doubts of the Community Doing Business Online", Journal of Physics: Conference Series, 2019

Publication

1%

6	Olawande Daramola. "Building an Ontology-Based Framework for Tourism Recommendation Services", Information and Communication Technologies in Tourism 2009, 2009 Publication	1 %
7	www.thecourse.us Internet Source	1 %
8	Submitted to George Washington University Student Paper	1 %
9	media.neliti.com Internet Source	1 %
10	Submitted to CSU, San Jose State University Student Paper	1 %
11	Submitted to CITY College, Affiliated Institute of the University of Sheffield Student Paper	<1 %
12	Kavita Devi, Shiv Prasad Yadav. "A multicriteria intuitionistic fuzzy group decision making for plant location selection with ELECTRE method", The International Journal of Advanced Manufacturing Technology, 2012 Publication	<1 %
13	Submitted to Anadolu University Student Paper	<1 %

14

Submitted to Cranfield University

Student Paper

<1 %

15

Submitted to University of Warwick

Student Paper

<1 %

16

Minako Sakai, Amelia Fauzia. "Islamic orientations in contemporary Indonesia: Islamism on the rise?", Asian Ethnicity, 2013

Publication

<1 %

17

Cengiz Kahraman. "Multi-Criteria Decision Making Methods and Fuzzy Sets", Springer Optimization and Its Applications, 2008

Publication

<1 %

18

Abdolreza Yazdani-Chamzini, Siamak Haji Yakhchali, Mahmood Mahmoodian. "Risk ranking of tunnel construction projects by using the ELECTRE technique under a fuzzy environment", International Journal of Management Science and Engineering Management, 2013

Publication

<1 %

19

Submitted to National College of Ireland

Student Paper

<1 %

Exclude quotes

On

Exclude matches

Off

Exclude bibliography

On

