# **PROGRAMME BOOK**





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## **Proceedings International Conference on Computer Science and Engineering**

INDUSTRIAL REVOLUTION 4.0 OPPORTUNITIES & CHALLENGES

26-27 April 2019 UPI Convention Center, Universitas Putra Indonesia "YPTK" Padang, Indonesia

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## PAGE

ORGANIZING COMMITTEE OF IC2SE 2019	1
WELCOME MESSAGES & PROFILE	
President Of Universitas Putra Indonesia VPTK Padang	Λ

President Of Universitas Putra Indonesia YPTK Padang	4
Rector Of Universitas Putra Indonesia YPTK Padang	5
Conference General Chair	6

## ABSTRACTS

Keynote Speaker 1 (IC2SE 2019)	7
Keynote Speaker 2 (IC2SE 2019)	8
Conference Schedule	10
Details Session Programme	11
List Of Abstracts	20



## **DETAILS SESSION PROGRAMME**

## Friday, 26<sup>th</sup> April 2019

Session 1, 1.30 – 03.30 pm Room 1, Ground Floor Session Chair: Dr. Mohd Khalit Othman		
Paper ID	Title of Paper	Author
2	Exploring the interaction's quality attributes of Mobile Government services	Abdulla Jaafar Mohamed, Mohd Khalit Bin Othman, Suraya Binti Hamid
6	Design of Bicycle's Speed Measurement System Using Hall Effect Sensor	Ratna Aisuwarya, Muhammad Azmi Riyan, Rahmi Eka Putri
54	Prediction of Corn Productivity in Indonesia as Anticipation Efforts to Import Using Backpropagation Neural Network	Anjar Wanto, Dedy Hartama, Risma Nurhaini Munthe, Pawer Darasa Panjaitan, Elfina Okto Posmaida Damanik, Agus Perdana Windarto
22	The Framework Accommodation of Systems Recommendation Via Social Media	Doni Ariyanto, Lukito Edi Nugroho, Adhistya Erna Permanasari
37	Practicality of E-Learning as Learning Media in Digital Simulation Subjects at Vocational School in Padang	Monica Fransisca, Yuliawati Yunus, Aminda Dewi Sutiasih, Renny Permata Saputri
Session 2, 04.00 – 05.30 pm Room 1, Ground Floor Session Chair : Billy Hendrik		
	Session Chair : Billy	Floor Hendrik
Paper ID	Session Chair : Billy Title of Paper	Floor Hendrik Author
Paper ID 58	Room 1, Ground         Session Chair : Billy         Title of Paper         Designing a Multimodal Graph System to Support Non-Visual Interpretation of Graphical Information	Hoor Hendrik Deni Setiawan, Bagus Priambodo, Mila Desi Anasanti, Al Hamidy Hazidar, Emil Naf'an, Inge Handriani, Asama Kudr Nseaf, Zico Pratama Putra
Paper ID 58 42	Room 1, Ground         Session Chair : Billy         Title of Paper         Designing a Multimodal Graph System to Support Non-Visual Interpretation of Graphical Information         Breast cancer classification using digital biopsy histopathology images through transfer learning	Floor         Hendrik         Deni Setiawan, Bagus Priambodo, Mila         Desi Anasanti, Al Hamidy Hazidar, Emil         Naf'an, Inge Handriani, Asama Kudr         Nseaf, Zico Pratama Putra         Ghulam Murtaza, Liyana Shuib,         Ainuddin Wahid Abdul Wahab, Ghulam         Mujtaba, Ghulam Mujtaba, Ghulam         Raza, Nor Aniza Azmi
Paper ID 58 42 49	Room 1, Ground         Session Chair : Billy         Title of Paper         Designing a Multimodal Graph System to Support Non-Visual Interpretation of Graphical Information         Breast cancer classification using digital biopsy histopathology images through transfer learning         Enhancement of OTP Stream Cipher Algorithm Based on Bit Separation	Floor         Hendrik         Deni Setiawan, Bagus Priambodo, Mila         Desi Anasanti, Al Hamidy Hazidar, Emil         Naf'an, Inge Handriani, Asama Kudr         Nseaf, Zico Pratama Putra         Ghulam Murtaza, Liyana Shuib,         Ainuddin Wahid Abdul Wahab, Ghulam         Mujtaba, Ghulam Mujtaba, Ghulam         Raza, Nor Aniza Azmi         Arisman, Mahyuddin K M Nasution,         Syahril Efendi
Paper ID 58 42 49 53	Room 1, Ground Session Chair : BillyTitle of PaperDesigning a Multimodal Graph System to Support Non-Visual Interpretation of Graphical InformationBreast cancer classification using digital biopsy histopathology images through transfer learningEnhancement of OTP Stream Cipher Algorithm Based on Bit SeparationOnline Management System of Praktik Lapangan Kerja (PLK) UPI YPTK Padang	Floor         Hendrik         Author         Deni Setiawan, Bagus Priambodo, Mila         Desi Anasanti, Al Hamidy Hazidar, Emil         Naf'an, Inge Handriani, Asama Kudr         Nseaf, Zico Pratama Putra         Ghulam Murtaza, Liyana Shuib,         Ainuddin Wahid Abdul Wahab, Ghulam         Mujtaba, Ghulam Mujtaba, Ghulam         Raza, Nor Aniza Azmi         Arisman, Mahyuddin K M Nasution,         Syahril Efendi         Astri Indah Juwita, Muhammad Ikhlas



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Session 1, 1.30 – 03.30 pm Room 2, Ground Floor Session Chair : Associate Professor Dr. Maizatul Akmar Ismail		
Paper ID	Title of Paper	Author
12	Supplier Selection by Using Analytical Hierarchy Process (AHP) and Techniques for Order Preference Methods with Similarities to Ideal Solutions (TOPSIS)	Ikhsan Siregar
39	Prediction of Canal Erosion on Tidal Swamp Delta Telang I, Banyuasin Regency, South Sumatra	Achmad Syarifudin, Henggar Risa Destania, Yunan Hamdani
64	Disaster risk management strategy in the environment and disaster mitigation-based school (SWALIBA)	Sindhung Wardana , Herdis Herdiansyah , Adam Wicaksono
68	Smart IoT Flood Monitoring System	Shahirah Binti Zahir, Phaklen Ehkan, Thennarasan Sabapathy, Muzammil Jusoh and Mohd Nasrun Osman, Mohd Najib Yasin, Yasmin Abdul Wahab, Hambali and N. Ali, A.S. Bakhit,F.Husin,M.K.Md.Kamil and R.Jamaludin
73	Shallow Well Water Salinity Viewed from Distance Of Well To CoastLine And Ground Water Level Elevation In Purus Padang Village	M Chairi, W Purba, W Boy, R Imani, J Melasari
54	A Flexible UWB Antenna for 5G Applications	Syuhaimi Kassim, Hasliza A Rahim, MohammedFareq AbdulMalek, Soh Ping Jack, Muzammil Jusoh, Wee Fwen Hoon, Nur Syahidah Sabil, Nurulisma Ismail
Session 2, 04.00 – 05.30 pm Room 2, Ground Floor Session Chair : Rima Liana Gema		
Paper ID	Title of Paper	Author
75	Face Recognition and Age Estimation Implications of Changes in Facial Features: A Critical Review Study	Rasha Ragheb Atallah, Amirrudin Kamsin, Maizatul Akmar Ismail
81	Standard Operational Procedure Fund Distribution System of Zakat Infaq and Shodaqah for Zakat Foundations	Inge Handriani, Bagus Priambodo, Al Hamidy Hazidar , Mardhiah Masril, Zico Pratama Putra , Asama Kudr Nseaf, Emil Naf'an
77	Automatic System to Fish Feeder and Water Turbidity Detector Using Arduino Mega	H Hendri , S Enggari , Mardison , M R Putra, L N



67	The Application of Data Mining in Determining Patterns of Interest of High School Graduates	Dedy Hartama, Agus Perdana Windarto, Anjar Wanto
36	Model Development Measurement of Interests Based on Expert System	Erdisna, Ganefri, Ridwan, Rice Novita, Wanayumini

Session 1, 1.30 – 03.30 pm Room 3, Ground Floor Session Chair : Halifia Hendri		
Paper ID	Title of Paper	Author
43	Bandit algorithms in information retrieval evaluation and ranking	Sinyinda Muwanei, Hoo Wai Lam, Sri Devi Ravana, Douglas Kunda
38	Analysis of Multiple Channel Multiple Phase System for Priorities Queuing Model (N-P) with Simple Adaptive Weighting	Herman Putra Rajagukguk, Muhammad Zarlis, Sutarman
28	Application Of Ahp Analysis To Increase Employee Career Paths In Decision Support Systems	Julius Santony, Faisal Amir, Sumijan, Rice Novita
23	Text Mining For Hotel Classification Using Naïve Bayes Algorithm	Ahmad Afif, Lukito Edi Nugroho , Adhistya Erna Permatasari
79	Design Of Expert System For Diagnosis Damage Computer Hardware	Retno Devita, Eva Rianti , Sri Rahmawati
	Session 2, 04.00 – 05 Room 3 Ground I Session Chair : Dr. Azah	5.30 pm Floor Anir Norman
Paper ID	Title of Paper	Author
19	Electronic Health Cloud as Service to Improve Collaboration in Healthcare Organizations	Shady Gomaa Abdulaziz, Norizan Mohd Yasin, Zeinab AlGamal, Asmaa Hateem and Kalaimagal Ramakrishnan
35	Expert Systems Diagnosing Of Banana Pests And Diseases Use Case- Based Reasoning Method With Android	Hezy Kurnia, Vicky Ariandi, Heriyanto, Yesri Elva
11	Technology Acceptance Among Older Adults With Mild Cognitive Impairement	Nita Rosa Damayanti, Nazlena Mohamad Ali, Ely Salwana Mat Surin



1	Decision Support System In Determining Structural Position Mutations Using The Simple Additive Weighting (Saw) Method	Aulia Fitrul Hadi, Randy Permana, Havid Syafwan
21	Design Chipless Textile Tag For RFID Application	Mirza Anuar, Lee Yeng Seng, M. S. Shakhirul, F.H. Wee, Hong Seng Gan, Muzammil Jusoh, Thennarasan Sabapathy, M.N. Osman

Session 1, 1.30 – 03.30 pm Room 4, Ground Floor Session Chair : Dr. Norizan Mohd Yasin		
Paper ID	Title of Paper	Author
03	A comparative analysis of detection mechanisms for emotion detection	Vimala , Marian Cynthia Martin, Wandeep Kaur, Amir Javed
55	Determination of the Shortest Route Towards the Tourist Destination Area Using the Ant Algorithm	Ni Luh Wiwik Sri Rahayu Ginantra , T , Gita Widi Bhawika , Ida Bagus Ary Indra Iswara , Anjar Wanto
18	Multiple Thresholding Methods For Extracting & Measuring Human Brain And 3d Reconstruction	Sumijan , Pradani Ayu Widya Purnama , Syafri Arlis
44	A Comparative Review of ISMS Implementation Based on ISO 27000 Series in Organizations of Different Business Sectors	Zaidatulnajla Hamdi , Azah Anir Norman , Nurul Nuha Abdul Molok
85	Improving the modelling of Robot Bunker with camera	Emil Naf`an, Riza Sulaiman, Nazlena Mohamad Ali, Bagus Priambodo, Al Hamidy Hazidar, Asama Kudr Nseaf, Zico Pratama Putra, Harry Theozard Fikri, Inge Handriani
Session 2, 04.00 – 05.30 pm Room 4 Ground Floor Session Chair : Rahmatul Husna Arsyah		
Paper ID	Title of Paper	Author
66	The Impact Analysis Of Flood Disaster In DKI Jakarta: Prevention And Control Perspective	Adam Wicaksono, Herdis Herdiansyah
08	Minimization of Palm Oil Losses on Sterilization Process by Optimization Boiling Pressure and Boiling time	Wetri Febrina, Yusrizal



13	Application of Theory of Constraints in Bottleneck Work Stations Optimization	Ikhsan Siregar
30	Designing Engineering Data Management System in Research and Development Company	Muhammad Nur, Luciana Andrawina
31	Risk Assestment of Housing Reconstruction Project Community- Based Construction after The Earthquake	Wendi Boy, Rafki Imani , Mayozi Chari
48	Industrial Revolution 4.2 Oppourtunity Challenges and Way Forward	Erry Yulian T. Adesta, Rudi Kurniawan Arief

Session 1, 1.30 – 03.30 pm Room 5, Ground Floor Session Chair : Dr. Nor Liyana Shuib		
Paper ID	Title of Paper	Author
46	How Online Media and Technology Inovation Influence Consumer's Purchase Intention	Sitti Rizki Mulyani , Larissa Navia Rani , Dharma Syahrullah Ekajaya , Marta Widian Sari , Vivi Nila Sari
47	Development Database E-Costal For Fishermen's Assistance Program At Terengganu	Dara Aisyah Ali Puteh, Al Hamidy Hazidar, Muhammad Sontang Sihotang
52	Assessment for Seismic Activities in Pesisir Selatan West Sumatra in 2018	R Imani , W Boy , U Dewi , A Sari , W Purba , M Chairi, J Melasari
41	Interactive Map Model of Flat Design for Istano Basa Pagaruyung Tourism Development	T Wiraseptya, R Imani, H Yanto
29	Behavioural Intention to Use MYOB Accounting Aplication Among Accounting Students	Dwi Fitri Puspa, Desi Ilona, Zaitul
Session 2, 04.00 – 05.30 pm Room 5 Ground Floor Session Chair : Dr. Vimala Balakrishnan		
Paper ID	Title of Paper	Author
17	The utilization of learning analytics to develop student engagement model in learning management system	Shahrul Nizam, Suraya Hamid , Haruna Chiroma



57	Backpropagation Neural Network Prediction For Cryptocurrency Bitcoin Prices	Rini Sovia, Musli Yanto ,Arif Budiman
62	Control System Of Microcontroller Based Automatic Milk Coffe Drink	Nofriadi ,Herman Saputra ,Juna Eska , Adi Prijuna , Nuriadi Manurung
24	Factors Influencing The Use Of M- Government Services From The Citizens' Perspective: Examining The Characteristics Of Adopters And Non- Adopters	J. Al-awj , N. Yasin , M. Khalit , S. Al- ammari ,N Kassim
98	Expert System For Disease Diagnosis In Cocoa Plant Using Android-Based Forward Chaining Method	Vicky Ariandi, Hezy Kurnia, Heriyanto, Hilda Mary
20	The Design of Sharia Housing Application In Padang City with CRM Concept	Hadi Syahputra, Raja Ayu Mahessya, Annisak Izzaty Jamhur, Ikhsan

Session 1, 1.30 – 03.30 pm Room 6, Ground Floor Session Chair: Dr. Suraya Hamid			
Paper ID	Title of Paper	Author	
27	Social Entrepreneurship Learning Model in Higher Education using Social Network Analysis	Muhammad Hamirul Hamizan Roslan, Suraya Hamid, Mohamad Taha Ijab, Sarah Bukhari	
14	Media Effectifity e- module Of Object-Oriented Programming II Based On Problem Based Instruction (PBI) Informatics Engineering Education Program, University Of Putra Indonesia YPTK Padang	Yuliawati Yunus, Silky Safira, Monica Fransisca, Renny Permata Saputri, Aminda Dewi Sutiasih	
61	Towards Data-driven Education with Learning Analytics for Educator 4.0	Salimah Mokhtar, Jawad A. Q., Ghassan O. A. Shahin	
<ul> <li>The Understanding of Lecturers about The New Literacy in Industrial Revolution Era 4.0: A Study case of University of Putra Indonesia YPTK Padang</li> </ul>		Muharika Dewi,Yulia Retno Sari, Shally Amna, Rasmita, Rina Susanti	
80	Impact of Learning Motivation, Cognitive and Self-Efficacy in Improving the Quality of Online Learning in the Industrial Age 4.0	Ramdani Bayu Putra, Elfiswandi, Muhammad, Sitti Rizki Mulyani , Dharma Syahrullah Ekajaya, Rio Andhika Putra	



Session 2, 04.00 – 05.30 pm Room 6 Ground Floor Session Chair: Dr. Hoo Wai Lam			
Paper ID	Title of Paper	Author	
26	The Impact of Age, Gender, and Educational level on the Cybersecurity Behaviors of Tertiary Institution Students: An Empirical investigation on Malaysian Universities	F B Fatokun, Suraya Hamid, Azah Anir Norman, J O Fatokun	
77	Automatic System to Fish Feeder and Water Turbidity Detector Using Arduino Mega	Halifia Hendri, Sofika Enggari, Mardison, Muhammad Reza Putra Larissa N Rani	
32	Digital Medical data protection compliance among medical staffs	Uning Pratimaratri, Desi Ilona, Zaitul	
16	Internet of Things in Monitoring and Notification of Industrial Security Systems	Alkhairunas Riyuska, Julius Santony, Sumijan	
15	Identification of Variables in Predicting Trends in Social Entrepreneurship	Nur Azreen Zulkefly, Norjihan Abdul Ghani, Wajdi Alquliti	
	Session 1, 1.30 – 03 Room 7, Ground 1 Session Chair : Dr. Azah	.30 pm Floor Anir Norman	
Paper ID	Title of Paper	Author	
Paper ID 25	<b>Title of Paper</b> A Socio-Technical Mitigation Effort to Combat Cyber Propaganda: A Systematic Literature Mapping	Author Aimi Nadrah Maseri, Azah Anir Norman	
Paper ID 25 70	Title of PaperA Socio-Technical Mitigation Effort to Combat Cyber Propaganda: A Systematic Literature MappingApplication Of Promotion, Map And Existing Tourism Information Systems In Solok Selatan District Using Androidjava Programming Language	Author Aimi Nadrah Maseri, Azah Anir Norman Hari Marfalino, Larissa Navia Rani, Mardison, Ichsan Pribadi	
Paper ID           25           70           10	Title of PaperA Socio-Technical Mitigation Effort to Combat Cyber Propaganda: A Systematic Literature MappingApplication Of Promotion, Map And Existing Tourism Information Systems In Solok Selatan District Using Androidjava Programming LanguageThe Kindness Behavior Management in Kindness Service Application Using Tree Structure	Author         Aimi Nadrah Maseri, Azah Anir Norman         Hari Marfalino, Larissa Navia Rani, Mardison, Ichsan Pribadi         Luxfy Roya , Lukito Edi Nugroho , Adhistya Erna Permatasari	
Paper ID           25           70           10           82	Title of PaperA Socio-Technical Mitigation Effort to Combat Cyber Propaganda: A Systematic Literature MappingApplication Of Promotion, Map And Existing Tourism Information Systems In Solok Selatan District Using Androidjava Programming LanguageThe Kindness Behavior Management in Kindness Service Application Using Tree StructureExpert System and Rule-Based Knowledge Based in Analyzing Vitamin Deficiency in the Human Body	AuthorAimi Nadrah Maseri, Azah Anir NormanHari Marfalino, Larissa Navia Rani, Mardison, Ichsan PribadiLuxfy Roya , Lukito Edi Nugroho , Adhistya Erna PermatasariRuri Hartika Zain, Elmi Rahmawati	
Paper ID         25         70         10         82         59	Title of PaperA Socio-Technical Mitigation Effort to Combat Cyber Propaganda: A Systematic Literature MappingApplication Of Promotion, Map And Existing Tourism Information Systems In Solok Selatan District Using Androidjava Programming LanguageThe Kindness Behavior Management 	AuthorAimi Nadrah Maseri, Azah Anir NormanHari Marfalino, Larissa Navia Rani, Mardison, Ichsan PribadiLuxfy Roya , Lukito Edi Nugroho , Adhistya Erna PermatasariRuri Hartika Zain, Elmi RahmawatiBagus Priambodo, Sarwati Rahayu , Ahmad , Al Hamidy Hazidar , Emil , Mardhiah masril , Inge , Zico Pratama Putra , Asama Kudr Nseaf , Deni Setiawan	



Paper ID	Title of Paper	Author	
5	Prediction of Malaysian stock market movement using sentiment analysis	Low Cheng Kuan ,Maizatul Akmar Ismail , Tasnim M. A. Zayet , Shuhaida Mohamed	
56	Decision Support System For Mapping Types Of Timber And Number Of Products For Furniture Handling In The Main Work Service Using Ahp (Analytical Hierarki Process) Method In Increasing The Profits Of Production	Firdaus , Ade Saputra , Mondra Neldi , Ritna ,Novia Yolanda , Usman	
80	Impact of Learning Motivation, Cognitive and Self-Efficacy in Improving Learning Quality Elearning in Industrial Era 4.0	Ramdani Bayu Putra, Elfiswandi , Muhammad Ridwan , Sitti Rizki Mulyani , Dharma Syahrullah Ekajaya , Rio Andhika Putra	
50	Convergence Analysis of Acceleration and Generalization of E-Learning in the Manifestation of Globalization Education Readiness 4.0	Sitti Rizki Mulyani, Agung Ramadhanu , Desi Permata Sari , Rahmatul Husna Arsyah , Neni Sri Wahyuni Nengsih	
97	Expert System Of Intrauterine Insemination	Firna Yenila, Yogi Wiyandra	

Session 1, 1.30 – 03.30 pm Room 8, Ground Floor Session Chair : Suparmi			
Paper ID	Title of Paper	Author	
7	Exploring Topic Difficulty in Information Retrieval Systems Evaluation	Wei Ting Pang, Prabha Rajagopal, Mengjia Wang, Shuxiang Zhang, Sri Devi Ravana	
71	The Effect of Lego Mindstorms as innovative educational tool: To develop students' creativity skills for Creative Society.	Mardhiah Masril, Billy Hendrik, Harry Theozard Fikri, Al Hamidy Hazidar, Bagus Priambodo, Emil Naf'an, Inge Handriani, Zico Pratama Putra, Asama Kudr Nseaf	
78	Learning Satisfaction Analysis of Online Learning Readiness with Learning Culture and Character Strength as Antecedent Variables	Agung Ramadhanu , Ramdani Bayu Putra, Hadi, Rahmatul Husna Arsyah , Desi Permata Sari	
33	Technology Context and Social Media Adoption Among Small-Medium Enterprise	Desi Ilona, Zerni Melmusi , Hanna Pratiwi, Padang, Indonesia), Zaitul	
34	Statistical Software Adoption Behaviour Among Undergraduate Students	Zaitul , Sitti Rizki Mulyani , Muhammad Ridwan , Desi Ilona	



Session 2, 04.00 – 05.30 pm Room 8 Ground Floor Session Chair : Associate Professor Dr. Sri Devi Ravana			
Paper ID	Title of Paper	Author	
04	Startup Learning Path (SLP): A Learning Model for Startup Employees Using Agile Learning Approach	Egi Endeska Putra, Ridi Ferdiana, Rudy Hartanto	
84	Fuzzy Logic Applications To Predict Total Production PKO (Palm Kernel Oil) In PT AAI Pasaman Method Using Web Based Tsukamoto	Devia Kartika, Mutiana Pratiwi, Rima Liana Gema	
51	<ul> <li>51</li> <li>Strengthening Character Education with the Implementation of Machine Learning in the Millennial Era Industrial Revolution 4.0</li> <li>Ulya Ilhami Arsyah, Rahmatul Arsyah, Mutiana Pratiwi, Nov</li> </ul>		
83	83Analysis of the Factors Affecting the Quality of Palm Oil Using the Analytical Hierarchy Process MethodNugraha Rahmansyah , Shary A Lusinia, Rima Liana Gema		
95	Analysis Of Electronically Reconfigurable Beam Steering Antenna Array Using Phase Shifter Technique	Soh Jen Neei, Muzammil Jusoh, Thennarasan Sabapathy, Samir Salem Al-Bawri, M.N. Yaasin, Tariq Abd Latef, Mahmud A. M. Albreem	
Session 1, 1.30 – 03.30 pm Room 9, Second Floor Session Chair : Abulwafa Muhammad			
Paper ID	Title of Paper	Author	
86	A Compact MIMO Planar Inverted-F Antenna	F Najwa , Mohamed Nasrun Osman Muzammil , Thennarasan Sabapath Thennarasan Sabapathy , M.M. Aziza Tarmizi Ali	
87	Transparent Encryption Technique for Trusted Computing	Gushelmi, Abdullah Mohd Zin	
89	University Student Satisfaction Analysis on Academic Services by Using Decision Tree C4.5 Algorithm (Case Study : Universitas Putra Indonesia "YPTK" Padang)	Tebri Aldi, Anita Ade Rahma	
90	Analysis System of Occupational Health and Safety In coal Underground Mining	Heri Prabowo, I Prengki, A Amran	
91	OLAP Approach in Searching Manufacturing Industries in West Sumatera	Eka Praja Wiyata Mandal, Dewi Eka Putri, Dede Wira Trise Putra,Dio Prima Mulya	
Session 2, 04.00 – 05.30 pm Room 9 Second Floor Session Chair : Aggy Permana Gusman			



Paper ID	Title of Paper	Author	
92	Setiment Analysis And Opinion Mining On Tax	Nurul Misyani Binti Mohd Rafie, Kasturi Dewi Varathan, Mohammad Shafenoor Amin	
93	Model Of Artificial Neural Networks In Predictions Of Corn Productivity In An Effort To Overcome Imports In Indonesia	Anjar Wanto, Dedy Hartama, Gita Widi Bhawika, Deswidya Sukrisna Hutauruk, Pinondang Hotria Siregar, Ricard Fredrik Marpaung, Salim Efendi, Rusmin Saragih, Imeldawaty Gultom, Agus Perdana Windarto	
94	Radiation Pattern Reconfigurable Fm Antenna	Barath, Thennarasan Sabapathy, Muzammil Jusoh, Samir Al-Bawri, M.N. Yaasin, Mohamed Nasrun Osman, Hasliza Abd Rahim	
96	Expert System Delayed Walking In The Toddler	Yogi Wiyandra, Firna Yenila, Hezy Kurnia, Suci Wahyuni, Ratih Purwasih	
99	Smart Irrigation System Based On Internet Of Things (Iot)	Nurulisma Ismail, Sheegillsha Rajendran, Wong Chee Tak, Tham Ke Xin, Nur Shazatushima Shahril Anuar Fadhil Aiman Zakaria, Yahy Mohammed Salleh Al Quhaif, Hussei Amer M. Hasan Karakhan, and Hasliz A. Rahim	
45	Analisy of the Health Service Quality Improvement Toward Patient Satisfaction Member of BPJS Grade III at Regional Public Hospital (RSUD) Pariaman by Using Importance Performance Analysis and Quality Fuction Deployment Quality	Vicky Brama Kumbara, Fitri Yeni, Rio Andika Putra, Dori Mitra Cendana, robby Dharma	

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## Designing a Multimodal Graph System to Support Non-Visual **Interpretation of Graphical Information**

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Abstract. While researchers have performed numerous studies to understand the human interpretation of visual graphs in reading, comprehending and interpreting displayed data; visually impaired (VI) users still face many challenges that prevent them from fully benefiting from these graphs. Thus, it influences their understanding of data visualization and in turn reduces their role in collaborating with their sighted colleagues in educational and working environments. We intend to develop a mobile application where visually impaired users can work together to build a collaborative graph that supported by data sonification in the mobile environment. The system properties were all tested by the task of identifying line trends in time series, which resulted in an accuracy of more than 80% for notes below 20 points. The usability testing has given result of 6.7 out 10 based on users' perception on the effectivity of the features.

#### 1. Introduction

The utilisation of auditory graphs, which deals with the use of non-speech sound to display information, has received much attention in recent years in a wide range of application scenarios. AudioGraf was an early attempt to make graphs accessible by using a touch panel and an auditory display [1]. TeDUB project made significant efforts to achieve existing Unified Modelling Language (UML) to make graphs accessible to the visual impaired (VI) listener [2]. Another study has developed a system, called PLUMB, which was designed to support people with VI to understand graphs and data structures by using auditory cues [3]. While the recent study has developed further using the Graph SKetching tool to incorporate VI users in computing and other science, technology, engineering and mathematics (STEM) disciplines in which graphs are essential [4].

Meanwhile, audio in the interface is becoming more important as technologies get smaller and portable. By shrinking screen sizes, the amount of information that can be displayed is limited, placing more importance on the use of audio to communicate information. Despite these clear reasons to support research on mobile auditory graphs, little has been done to explore multimodal mobile

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graphing system on mobile device for collaborative work. To date, the closest work to our study has been developed by researchers from Monash University, GraCALC, as an approach for implementing numerical and statistical graphics to VI [5]. The system presents a graphic from a mathematical function as a line graph which then displayed on a web-based service. Graphics are displayed on a visual screen on the iPad. The interface has been intended to utilise VoiceOver screen reader and the standard iOS framework. As the user explores the display, the system determines a combination of speech, non-speech audio, and tactile (through vibration motors attached to the fingers) feedback to allow the users to explore the screen. However, it is not designed for collaborative work study.

To cover this gap, our study aimed to develop the app to help VI users to work collaboratively with their peers to estimate the trend in auditory graphs using real-time database in a mobile device. The designed app can serve as a good alternative for VI users instead of the portable traditional embossed graphs that is widely used in education for teaching blind student.

### 2. Related Work

Multimodal multi-sensor interfaces may connect one or multiple user input modalities and extract information from sensors (e.g., camera, microphone, touch screen, position, acceleration, proximity, tilt) [11]. Users can perform intentional actions when using sensor controls, such as tilting a screen to change its orientation. In addition, sensors can also serve as "backend control" for the interface to adapt automatically and without the user's intentional intervention (e.g., dimming the telephone screen when not in use). The purpose of sensor input is to make the interaction between user and system and the adaptation to the needs of the user transparent.

## 2.1. Non-Visual Mobile Multimodal Interaction

The navigation on a mobile device, which benefits both the sighted and the VI, has been investigated in a number of studies. Amar [7] designed the prototype handheld called ADVICE, integrating a Tactile Feedback and Acoustic Display on an embedded mobile device for the visually impaired. Sanchez [8] has designed desktop and mobile applications based on pointing gestures to help VI users travel on the city rail. The BlindSight system is based on the phone's physical keyboard, ensuring eye-free navigation through auditory feedback during telephone calls [9].

Slide Rule developed by Kane et al [10] enabling multimodal touch gestures in mobile device interaction. Also, using gestures on mobile touchscreen devices, Kane et al. considered a new set of rules to improve access to mobile devices. A pilot study was carried out by Metatla [11] to investigate menu navigation in an eyes-free manner related to execution times and mental stress. Their findings showed that users were considerably slower with a menu item search than with visual or audio-only displays based on a portable touch screen device when using a menu with an audio-haptic display.

To date, we did not find any related study aiming to implement the auditory graph for collaborative work in mobile device as we present in this study.

### **3. Prototyping Methodology**

The prototype was developed based on the Android Operating System on Google Nexus 7 tablet, which runs the TalkBack screen reader and on a Samsung 9.7-inch Galaxy Tab S2 with a larger screen and haptic feature. This screen reader is a feature that helps blind and VI users receive the data by using loudly spoken text when touching, selecting or activating objects on the screen. Iterative Prototyping is the approach used in this project, in which the design of the prototype was iteratively generated and evaluated by potential users. The feedback and the evaluation of the last iteration is the prerequisite for the subsequent iteration.

The first iteration was the low-fidelity prototype for sharpening the goal and checking the significance of the collaboration graph. Two participants were involved and gave many suggestions for the next extensible development of the application. The idea was to share the role between teacher and student analogues and let them work collaboratively. The second iteration focused on extending the functionality of the application to implement the analogies of teacher and student into the system. The Publisher and Subscriber model was used as shown in Figure 1. The teacher acts as a publisher who can create a diagram and share it with other publishers or students. The Subscriber role is almost identical to the Student Analogy role, where they can access all available diagrams without editing

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them. Second, this iteration explored the concept of managing workgroups and multiple graphs. In this way, users can group and share all diagrams with the same group member. To achieve the goal of this iteration, only the low fidelity prototype was used in this iteration. The participants also saw participants to evaluate the interface.



Figure 1. Paper low-fidelity prototype of subscriber and publisher

The third iteration was the high-fidelity prototype to allow the participants virtually complete evaluation. The sighted and visually impaired participants were shown difficulty when entering the forms into the system, but overall the system was consistent with the objective of the project. Sighted users, on the other hand, found many errors such as lack of registration unexpected shutdown of the system, and the inconsistent elements of the layout, such as key texts and key positions. The final iteration covered all full functions focused on completing all system functionalities and measuring the usability of the application. This iteration introduced the real-time update functionality.

Search page	
1	IND 0 1 2 3 4 5 6 7 8 9 60 60 60 50 50 50 50 50 50 50 50 50 50 50 50
BROWSE CHARTS	40 40 40 10 10 10 10 10 10 10 10 10 10 10 10 10
BACK	200 10 10
	EDIT CHART REFRESH PLAY BACK
	1:2
< ● □	2:3

Figure 2. Subscriber interface for login (left) and graph display (right)

#### Journal of Physics: Conference Series

1339 (2019) 012059

59 doi:10.1088/1742-6596/1339/1/012059



Figure 3. (a) Interface for publisher for login, (b) interface of workgroup management, and (c) the graph display interface.

Each time a publisher updates a graph, the graph on the subscriber page is automatically updated without pressing the Refresh button (see figure 2 and 3). Figure 2 and 3 above respectively shows the additional table appended at the end of the page as mentioned in the previous iteration. Therefore, both pair VI user are able to read and display the values of the graph sequentially in tabular format. The visual impaired participants evaluated the system profoundly and, for overall, gave positive feedbacks for this application.

## 4. Evaluation Method

Five (5) VI participants, aged 19-64, are involved in this iteration. The number was minimal as it is difficult to recruit visually impaired people to test this application in London. Although the number of participants is noticeably small, Nielsen [12] argued that five participants are sufficient to detect these real problems in a usability test.

A brief explanation of the mobile auditory graph was given and a 10-minute listen to the auditory graph to introduce themselves to the sound. As all participants were visually impaired people, the instructions for this evaluation were detailed to let them run the test smoothly. The password and username were only suggested with the number for efficiency when they enter the login or registration form. The task is divided into two sections, the first is the user acts as a subscriber / student. Second, he or she will be a publisher / teacher.

#### 5. Result and Discussion

The first testing is aiming to measure the usability for the role of the subscriber. Participants are given a set of instruction to find the graph by inserting the graph\_id number. Improvement over the previous iteration, the format of the keyboard has been changed to the keyboard for the telephone interface, therefore only the number is displayed without further characters. This helped the participants to fill in the form quickly and easily.

The observation did not reveal any noticeable problem for the participant. Participants are asked to answer how many rising and falling trends there are in the graph. The total note on the graph for the first task was only 10, followed by 20 notes on the second task and 30 notes on the third task. The accuracy of the participants' trend identification during the usability test had revealed that the participants were able to estimate the trend with less than 20 points representing a percentage of more than 80, but it dropped significantly to 40% when they were asked to estimate the trend in 30-point graphs. The findings confirms Harrar [13] research that adding complexity to auditory graphs could

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drop the performance of graph identification. Further, Nees and Walker [14] confirmed that more trend reversal also led to performance drops.

The second aspect concerned the application features such as navigation, page, graphs, workgroup and so forth as participants have to answer questionnaire and gave their feedback. Starting with the question about the performance of the screen reader in the application, the result was relatively low with 5.8. In fact, one participant was not familiar with the Talkback. Norman [15] pointed out that a user's understanding of a new user interface is based on prior knowledge. Therefore, it is reasonable that the participant had difficulties using the application and gave negative feedback in the questionnaire. However, other participants said that the screen reader worked well with the application.

The next aspect was clarity, which notes how accessible the presentation of working groups, graphs and points is. The result was 6.0 out of 10, which means the interface was acceptable to the users. Together with the evaluation of the navigation used in this application, the result was 6, which means that the navigation is sufficient.

The most important evaluation in this study is the sonification performance that reached the higher score of 7.4. This means that the sonification technique worked well to help the user to perceive the graph. The feedback was also validated to ensure that users have full control over the application and know what is happening in the system. The result was 6.4 that it meant the users were satisfied with the feedback. The next point is the usability of the graph and the entire application. The results were 6.8 and 7.4, respectively that user consider the system is very helpful not only to display the graph but also to help users work collaboratively. The result shows that locate a graph, creating a workgroup, creating a graph, adding or deleting a point was very acceptable to the participant with the average number was between 6.6 and 7.

Finally, the changing role was also tested. In the beginning the participants were slightly disoriented about the role differences. Although there are several suggestions from participants to bring roles together, it is important to distinguish the roles, considering in real scenarion, the participant may basically be a student who receives only the final graphics from the teachers. The average rate result was 7.2, which means that the mechanism seemed to be acceptable.

During the test period, a number of feedback messages were summarised. Some participants said they were confused with the role's function and suggested using only one role in the application. However, this may be because participants were unfamiliar with the function of the different roles and thought they would merge them. Also, a constructive suggestion to implement pause function to control the playback sound. It is reasonable, because the performance of trend detection decreased with increasing number of points in the graph.

#### 6. Conclusions

In this study, we performed a test employing five VI participants to confirm how well the mobile auditory graph could help them for collaborative work. This study aims to develop an application to support visually impaired people in creating a collaboration graph. The prototype was built by four prototype iterations. The first iteration focused on extending the objectives and aggregating the requirements. The second iteration was a low fidelity prototype that examined the system adaptations with the specifications. The third was the high-fidelity prototype, where almost all features were present in this iteration. In this iteration, a synchronization button was also introduced to aggregate the updated graph. In the last iteration the real-time function was added. All functions were tested by conduction trend identification task, resulting accuracy more than 80% for notes less than 20 points. The usability test was performed with the result 6.7 out of 10, means that the systems' usability was effective and efficient. This is a best alternative instead of the portable traditional embossed graphs which is more time-consuming to produce and harder to replicate.

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# CERTIFICATE

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## PARTICIPANT

In International Conference On Computer Science And Engineering "Strategies to Face Industrial Revolution 4.0" on Friday-Saturday, April 26-27<sup>th</sup>, 2019 at UPI Convention Center, Padang, West Sumatera, Indonesia

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