



ISIITA 2024

HYBRID MODE (Virtual & Physical)

International Symposium on Innovation in Information Technology and Application

PROGRAM

University of the Philippines Cebu, Philippines
January 15-18, 2024



Organized by

International Society for Information Technology and Application (ISIITA)

University of the Philippines Cebu

DU_The Research Institute for Special Education & Rehabilitation Science

(NRF-2022S1A5C2A07091326)

WELCOME ADDRESS

Welcome to 2024 International Symposium on Innovation in Information Technology and Application A sincere welcome awaits all visitors.

As we entered the 21st century, the rapid growth of information technology has changed our lives more conveniently than we have ever speculated.

Recently in all fields of the industry, heterogeneous technologies have converged with information technology resulting in a new paradigm, IT convergence, and people have been breaking the limit and finding other possibilities of IT research and development through converging with various industries and technologies.

The goal of this conference is to discover a new progressive technology by upgrading the previous technologies and to solve the technical problems that may have occurred in the process of converging technology in various fields of industry.

The International Symposium Innovation in Information Technology Application (ISIITA) 2024, the world's premier networking forum of leading researchers in the highly active fields of information technology application, will be held in Cebu island, Philippines. The ISIITA 2024 will include oral and poster sessions as well as tutorials given by experts in state-of-the-art topics.

IT experts, researchers, and practitioners from each field are invited to share ideas and research technologies; moreover, encouraged to cooperate with each other to overcome the confronted technical problems. As a result, this conference will become a place of knowledge where a variety of effects can be created.

We are proud to invite you to Cebu island, Philippines, which is a perfect setting for the Joint Conference. We truly hope that you will have a technically rewarding experience as well as some memorable experiences in Cebu island, Philippines.

It is our hope that you're participating in ISIITA 2024 will be a rewarding experience and that you will get a chance to meet other colleagues working in the exciting area of industrial information systems. We are all looking forward to seeing you in Cebu island, Philippines.

A sincere welcome awaits all visitors at the joint conference.

Sang Hyuk LEE

General Chairs

New Uzbekistan University, Uzbekistan

Robert R. Roxas

General Chairs

University of the Philippines Cebu,
Philippine

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Conference Secretary	Hyung Gyu Lee (Duksung Women’s University, Korea)

PROGRAM AT A GLANCE

Time	Event
Jan 15 2024	
13:30~15:15	SIG Meeting I
15:15~15:35	Coffee Break
15:35~16:35	SIG Meeting II
Jan 16 2024	
08:30~09:00	Registration
09:00~09:20	Opening Ceremony (Room: PAH)
09:20~10:20	Keynote I (Room: PAH)
10:20~10:30	Coffee Break
10:30~12:00	Session 1 (Room: PAH)
12:00~13:00	Lunch
13:00~14:30	Session 2 (Room: PAH)
14:30~14:40	Coffee Break
14:40~15:50	(Room: AVR-1) Special Session 3 Session 4 (Posters & Capstone) (Room: PAH)
15:50~16:00	Coffee Break
16:00~17:10	(Room: PAH) Session 5 Session 6 (Room: AVR-1)
17:10~18:30	Move to Crimson Resort: Bus service
18:30	Banquet (Coral 1 & 2 in Crimson Resort)
Jan 17 2024	
09:00~10:30	Session 7 (Room: PAH)
10:30~10:50	Coffee Break
10:50~12:20	Session 8 (Room: PAH)
12:20~13:30	Lunch
13:30~14:40	Session 9
14:40~14:50	Break
14:50~15:50	Session 10
15:50~17:00	Session 11 Special Session 12
Jan 18 2024	
09:00~11:30	Interactive Networking
11:30~11:40	Committee Meeting
11:30	Closing Ceremony

SCIENTIFIC PROGRAM

January 15 2024	
Time	Content
13:30 ~	SIG Meeting I
15:15 ~	Coffee Break
15:35 ~	SIG Meeting II
16:35 ~	

January 16 2024	
Time	Content
08:30 ~	Registration
09:00 ~	Opening Ceremony (General Chair, Vice Chancellor of Academic Affairs UP Cebu)
09:20 ~	Keynote I (Dr. Charibeth Cheng)
10:10 ~	Coffee Break
10:30 ~	Session 1: Analyzing and Optimizing for Deep Learning Chair: Yoosoo Oh (Daegu Univ.)
	1S-1 A Study on Performance Analysis of RNN Architecture Using Unbalanced Network Dataset Donghwoon Kwon ¹⁾ , Asser Nasser Moustafa ¹⁾ , and Jeong-Tak Ryu ²⁾ ¹⁾ Dept. of Computer Science and Engineering, North Central College, Naperville, IL 60540, USA ²⁾ School of Electronic and Communication Engineering, Daegu University, Gyeongsan-si, South Korea
	1S-2 A Study on Prediction of Closing Stock Prices Using a Convolutional Neural Network Model Even Nybo ¹⁾ , Joshua Buhr ¹⁾ , Nicklaus Campanella ¹⁾ , and Donghwoon Kwon ^{1)*} ¹⁾ Dept. of Computer Science and Engineering, North Central College, Naperville, IL 60540, USA
	1S-3 Feasibility of Transfer Learning for Network Anomaly Detection Donghwoon Kwon ^{1*)} , Naveen Chennaipalem ²⁾ , Junekyoung Lee ³⁾ , and Jinoh Kim ²⁾ ¹⁾ Dept. of Computer Science and Engineering, North Central College, Naperville, IL 60540, USA ²⁾ Computer Science Department, Texas A&M University, Commerce, TX 75429 ³⁾ NaonWorks Inc., 7F (Byeoksan Digital Valley 3), 271, Digital-ro, Guro-gu, Seoul, Korea
	1S-4 Active and Passive Learning Approaches in Computer-mediated Platform do not significantly differ in e-Learning Gains Ethan Chav Isaac P. Sumalinog ¹⁾ and Demelo M. Lao ^{1*)} ¹⁾ Department of Computer Science, College of Science, University of the Philippines Cebu, Lahug, Cebu City 6000, Cebu, Philippines.

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	1S-5 A Deep Learning Framework for Protecting Personal Computers from Unauthorized Mobile Screen Recordings <i>Ihsan Ullah¹⁾, Rock Hyun Choi¹⁾ and Hyunki Lee^{1*)}</i> ¹⁾Division of Intelligent Robotics, DGIST, Daegu, 42988, South Korea
	1S-6 Automatic Data Transformation System for Regressor and Classifier <i>Sehyun Myeong¹⁾, Yoosoo Oh^{2,*)}</i> ¹⁾School of AI, Daegu University, Gyeongsan-si, Republic of Korea ²⁾School of AI, Daegu University, Gyeongsan-si, Republic of Korea
12:00 ~	Lunch
13:00 ~	Session 2: Machine Learning and Applications Chair: Hyunki Lee (DGIST)
	2S-1 Securing Truth: Integrated Deep fake Detection with Advanced Fusion Techniques <i>Javokhir Jumaboev¹⁾, Mohamed Uvaze Ahamed Ayoobkhan^{1*)}</i> ¹⁾Department of Computer Science, New Uzbekistan University, Tashkent, Uzbekistan.
	2S-2 Hesitation Analysis and Score Function Design on Intuitionistic Fuzzy Set Data <i>Sanghyuk Lee^{1*)}, Yuliya Durova¹⁾</i> ¹⁾Department of Computer Science, New Uzbekistan University, Tashkent, Uzbekistan
	2S-3 Online Machine Learning: Adapting to Dynamic Data Streams in Real Time <i>Diyorbek Usmanov¹⁾</i> ¹⁾Department of Computer Science, New Uzbekistan University, Tashkent, Uzbekistan.
	2S-4 Method to reduce false-positive errors using discretization and short-term filter for mobile device detection <i>Rock Hyun Choi¹⁾ and Hyunki Lee^{1*)}</i> ¹⁾Division of Intelligent Robotics, DGIST, Daegu, 42988, South Korea
	2S-5 Analysis of The Number of Views According to The YouTube Title using a Regression Algorithm <i>Hyeonji Kim¹⁾ and Yoosoo Oh^{2,*)}</i> ¹⁾Dept. of Information and Communication Engineering, Daegu University, Gyeongsan-si, Korea ²⁾School of AI, Daegu University, Gyeongsan-si, Republic of Korea
	2S-6 Music Genre Classification of Philippine Music <i>Alden Robell M. de Loyola^{1*)} and Robert R. Roxas¹⁾</i> ¹⁾Dept. of Computer Science, University of the Philippines Cebu, Cebu, Philippines
14:30 ~	Coffee Break
14:40 ~	Session 3: Inclusive Education and Assistive Technology Chair: Kyeong Ock Park (Daegu Univ.)
	3S-1 A National Snapshot of Assistive Technology for Students with Special Needs in South Korea <i>Jiyeon Kim¹⁾</i> ¹⁾Dept. of Adapted Physical Education, Korea National Sport University, Seoul 05541, Korea
	3S-2 The Usefulness of Korean Painting in Art Therapy : Focusing on the Therapeutic Factors <i>Byeongmun Son¹⁾, Eunyeong Choi^{2*)}, and Enok Bae¹⁾</i> ¹⁾The Research Institute for Special Education & Rehabilitation Science, Daegu University, Korea ²⁾Dept. of Rehabilitation Psychology, Daegu University, Republic of Korea

	3S-3 Special Education Teachers' Experiences and Perceptions Regarding the Use of Artificial Intelligence for Teaching Students with Disabilities Min Wook, Ok¹⁾, Kyoung Ock, Park²⁾ and Jiyeon, Kim³⁾ ¹⁾Dept. of Special Education, Daegu University, Gyeongsan, 38453, Republic of Korea ²⁾Dept. of Elementary Special Education, Daegu University, Gyeongsan, 38453, Republic of Korea ³⁾Dept. of Adapted Physical Education, Korea National Sport University, Seoul, 05541, Republic of Korea
	3S-4 The Development of Metaverse-based Educational Content for Improving Social Skills of Students with Developmental Disabilities Kyungin Han¹⁾, Daesong Lee²⁾, Seohyeon Noh³⁾, Yunhee Shin⁴⁾ and Kyuman Jeong⁵⁾ ¹⁾Institute of Special Education & Rehabilitation Science, Daegu University, Republic of Korea ²⁾Gyeongsangnamdo Hamyang office of Education, Hamyang-Gun, Republic of Korea ³⁾Bansong Elementary School, Changwon-si, Republic of Korea ⁴⁾Behavior Therapy, Daegu Cyber University, Gyeongsan-si, Republic of Korea ⁵⁾School of AI, Daegu University, Gyeongsan-si, Republic of Korea
	3S-5 The Effect of Positive Behavior Support Through Non-face-to-face Coaching on Self-harming Behavior and Classroom Participation Behavior in High School Students with Developmental Disabilities Juyeonr Yun¹⁾, Kyoungock Park²⁾ and Pureum Ji, Gyouhee Kim¹⁾ ¹⁾The Research Institute for Special Education & Rehabilitation Science, Daegu University, Korea ²⁾Dept. of Elementary Special Education, Daegu University, Republic of Korea
14:40 ~	Session 4A: Interactive Posters Chair: Jeong Tak Ryu (Daegu Univ.)
	4S-1 Radar Signal Processing Scheme for Human Identification YoungSeok Jin¹⁾, Ji-Eun Bae¹⁾, Inoh Choi¹⁾, and Eugin Hyun¹⁾ ¹⁾Division of Automotive Technology, DGIST, Daegu, Republic of Korea
	4S-2 Mastectomy skin flap stability prediction using indocyanine green angiography : A randomized prospective trial Min Ji Kim¹⁾, Hyoseob Lim¹⁾, and Il Jae Lee¹⁾ ¹⁾Department of Plastic and Reconstructive Surgery, Ajou University School of Medicine, Suwon, Korea.
	4S-3 A method for improving latency between devices equipped with speakers Cheoljae Kim¹⁾, Seokwon Hong²⁾, Hyeol Yang³⁾, and Kyuman Jeong³⁾ ¹⁾Dept. of Information and Communication Engineering, Daegu University, Daegu, Korea ²⁾An Industry-Academic Cooperation Group, Daegu University, Daegu, Korea. ³⁾School of AI, Daegu University, Daegu, Korea
	4S-4 Learning deep models for face anti-spoofing by pixel-wise supervision with depth labels Myoung-Kyu Sohn¹⁾, Sang-Heon Lee¹⁾, Hyunduk Kim¹⁾, and Junkwang Kim¹⁾ ¹⁾Division of Automotive Technology, DGIST, Daegu, Republic of Korea
	4S-5 Selective Alignment of DNA Molecules using Local Surface Charges controlled by Plasma Ashing Method Hyung Jin Kim¹⁾ and Doyoung Kim¹⁾ ¹⁾Dept. of Electrical & Electronic Engineering, Ulsan College, Ulsan 44610, Korea
	4S-6 The effects of various core exercise on biomechanical properties of lower limb muscles in healthy young individuals during 12-weeks Hyuk-Jae Choi¹⁾, Won-Young Lee²⁾, InHo Hwang¹⁾, Chang-Yong Ko³⁾ and Sung-Phil Heo⁴⁾ ¹⁾Dept. of Research & Development, Rehabilitation Engineering Research Institute, Korea Workers' Compensation & Welfare Service, Incheon 21417, Korea ²⁾Dept. of Institute of Sports Medicine, Hannam University, Daejeon 34430, Korea ³⁾Dept. of Research & Development, Refind Inc., Wonju 26354, Korea ⁴⁾Gangneung-Wonju National University, Wonji-si, 26403, Korea

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	4S-7 ANN-based Pet Activity Recognition with Wearable Sensors <i>Heerae Lee¹⁾, Seongyeong Kim¹, and Hyung Gyu Lee^{1,*)}</i> ¹⁾Dept. of Software, Duksung Women's University, Seoul 01369, Korea
16:00 ~	Session 5: Innovative Solutions in Mobile Systems and Security Chair: Hyung Gyu Lee (Duksung Women's Univ.)
	5S-1 Collaboration-focused Network Design for Return & Collection in a Delivery Services <i>Muzaffar Makhmudov¹⁾ and Chang Seong Ko^{2*)}</i> ¹⁾Department of Industrial Management, New Uzbekistan University, Uzbekistan ^{2*)}Department of Industrial and Management Engineering, Kyungsoong University, Korea
	5S-2 Operating System Security Vulnerabilities in Autonomous Vehicles <i>Clint Scholtisek¹⁾, Connor Kreis²⁾, Kamran Siddique^{3*)}, Mengwen Wang⁴⁾, Yuechun Wang⁵⁾, and Ka Lok Man⁶⁾</i> ¹⁾²⁾³⁾ University of Alaska Anchorage ⁴⁾⁵⁾ Sanda University, Shanghai, China. ⁶⁾Xi'an Jiaotong-Liverpool University, Suzhou, China.
	5S-3 An Exploratory Case Study of TempleOS: An Open-Source Lightweight Operating System <i>Tremayne Booker¹⁾, Mary Kollander²⁾, Puah Jia Hong³⁾, Kamran Siddique^{4*)}, Xieyang Zhou⁵⁾, Yuechun Wang⁶⁾, and Ka Lok Man⁷⁾</i> ¹⁾²⁾³⁾⁴⁾ School of Computer Science and Computer Engineering, University of Alaska Anchorage Anchorage Alaska, United States ⁵⁾⁶⁾ Dept. of Information Science and Technology, Sanda University, Shanghai, China. ⁷⁾ School of Advanced Technology, Xi'an Jiaotong-Liverpool University, Suzhou, China.
	5S-4 Design of Blockchain-based Network System for Multi-domain V2G Environments <i>DeokKyu Kwon¹⁾, Seunghwan Son¹⁾ and Youngho Park^{1*)}</i> ¹⁾School of Electronic and Electrical Engineering, Kyungpook National University, Daegu 41566, Korea
	5S-5 Estimating Software Project Performance Using Factor Analysis and Sequential Equation Modeling <i>Khumoyun Aminaddinov Ravshanovich¹⁾, Lionel Randall Kharkrang²⁾</i> ¹⁾Dept. of Computer Science, New Uzbekistan University, Tashkent 10000, Uzbekistan ²⁾Dept. of Physics, National Institute for Astrophysics, University of Trieste, Italy
	5S-6 Novel RectER Circuit For Energy Harvesting For High Output Voltage <i>Wend Yam Ella Flore NIADA¹⁾, You Chung CHUNG²⁾</i> ¹⁾Dept. of Electronic Engineering, Daegu University, Gyeongsan, Korea ²⁾Dept. of Information and Communication Engineering, Daegu University, Gyeongsan, Korea
16:00 ~	Session 6: Automated Service Impact Analysis Chair: Min Ho Ryu (Dong-A Univ.)
	6S-1 A Study on the Effect of the Bank's Automatic Call Service <i>Sohui Kim¹⁾ and Min Ho Ry^{1*)}</i> ¹⁾Dept. of Management Information System, Dong-A Univ., Busan 49236, Korea
	6S-2 Beacon -Voice Assistant for Impaired People on Windows PC <i>Truong Quoc Thang^{1*)}, Pham Quoc Bao, Nguyen Van Vi¹⁾, Than Thi Thao¹⁾, Nguyen Trieu Tien¹⁾, Tran Kim Sanh¹⁾</i> ¹⁾International School, Duy Tan University, DaNang City, 550000, Vietnam
	6S-3 Online Learning Platform with a Content Summarization Tool <i>Dang Nhat Minh^{1*)}, Do Minh Nhat, Phan Nhat Tuan¹⁾, Pham Anh Quyet¹⁾, Tran Minh Tu, Huynh Ba Dieu¹⁾</i> ¹⁾International School, Duy Tan University, DaNang City, 550000, Vietnam

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	6S-4 Apply Decision Trees Algorithm To Build The Wellness Navigator Management System <i>Nguyen Huu Vien¹⁾, Tran Duy Tung¹⁾, Do Tien Thanh¹⁾, Vo Van Hao¹⁾, Tran Thi Thuy Trinh¹⁾</i> ¹⁾Internation School, Duy Tan university, Da Nang city, 55000
	6S-5 Identifying and Extracting Sentiment Words Using Reason-Sentiment Pattern <i>Woo Hyun Kim¹⁾ and Heejung Lee²⁾</i> ¹⁾Dept. of Industrial Data Engineering, Hanyang University, Seoul 04763, Korea ²⁾School of Interdisciplinary Industrial Studies, Hanyang University, Seoul 04763, Korea
17:10 ~	Move to Crimson Resort: Bus service
18:30 ~	Banquet

January 17 2024	
Time	Content
09:00~	Session 7: Cutting-edge Medical AI Innovations Chair: Hyunduk Kim (DGIST)
	7S-1 SS-GAN-ViT: Advancing Multi-label Chest Image Annotation Through Self-Supervised Learning, Adversarial Networks, and Vision Transformers <i>Sang Suh¹⁾, Sobha Rani Ponduru¹⁾, Nikitha Tammareddy¹⁾, and Bhavana Makkena¹⁾</i> ¹⁾Department of Computer Science, Texas A&M University-Commerce, Commerce, TX, U.S.A.
	7S-2 Medichat – A Medical Chatbot with Multilingual Support <i>Sang Suh¹⁾ and Rama Krishna Kamma¹⁾</i> ¹⁾Department of Computer Science, Texas A&M University - Commerce, Commerce, TX, U.S.A.
	7S-3 Visualization Tool: Exploring COVID-19 Data <i>Donghyun Jeon^{1*)}, Jong Kwan Lee¹⁾, Prabal Dhaubhadel¹⁾, and Aaron Kuhlman¹⁾</i> ¹⁾Dept. of Computer Science, Bowling Green State University, Bowling Green, Ohio 43403, U.S.A.
	7S-4 Research on human 2D edge sample point to 3D mesh coordinate conversion <i>Junkwang Kim¹⁾, Myoung-Kyu Sohn¹⁾, Sang-Heon Lee¹⁾, and Hyunduk Kim¹⁾</i> ¹⁾Division of Automotive Technology, DGIST, Daegu, Republic of Korea
	7S-5 Remote Heart Rate Estimation using Swin Transformer V2 and Wrapping Temporal Shift Modules <i>Hyunduk Kim¹⁾, Sang-Heon Lee¹⁾, Myoung-Kyu Sohn¹⁾, and Junkwang Kim¹⁾</i> ¹⁾Division of Automotive Technology, DGIST, Daegu, Republic of Korea
	7S-6 Using Deep Learning to Determine Time and Geographic Trends of Sentiments Towards Covid-19 Vaccine <i>Alex A. Diola ^{1*)} and Robert R. Roxas ²⁾</i> ^{1, 2)}Dept. of Computer Science, University of the Philippines Cebu, Cebu, Philippines
10:30~	Coffee Break
10:50 ~	Session 8: AI for Medical Analysis Chair: T. Velmurugan (Dwaraka Doss Goverdhan Doss Vaishnav College)
	8S-1 Classification of Tuberculosis in Chest X-rays using SMOTE-enhanced Neural Networks (SMONN) <i>SriPradha. G¹⁾, J.Vanathi²⁾ and T.Velmurugan^{3*)}</i> ^{1,2)}Guru Nanak College(Autonomous),Velachery,Chennai-600042 ³⁾PG and Computer Science D. G. Vaishnav College, University of Madras, Chennai-600106

	8S-2 Making use of Image Processing along with Machine Learning techniques, examination of leaf composition, and disease detection <i>M.Robinson Joel¹⁾, T.D.Jeba Freeda²⁾, and Prince Immanuel J³⁾</i> ^{1,3)}Department of Information Technology Kings Engineering College, Chennai, India. ²⁾Department of Computer Science, Noorul Islam College of arts and Science, Kumaracoil
	8S-3 Performance Analysis of k-Means and Fuzzy C-Means (FCM) Clustering Algorithms for Diabetic Dataset <i>K. Emayavaramban¹⁾ and T. Velmurugan²⁾</i> ¹⁾Loganatha Narayanaswamy Arts College (Autonomous), ponneri, India. ²⁾PG and Research Department of Computer Science, D.G. Vaishnav College, Chennai
	8S-4 A Study on Disease Detection Methods in Sugarcane Plants Using Conventional Neural Network in Deep learning <i>T. Angamuthu¹⁾ and A.S. Arunachalam¹⁾</i> ¹⁾Vels Institute of Science, Technology and Advanced Studies, Pallavaram, Chennai, Tamil Nadu 600117, India
	8S-5 Integrated BERT and Rule-based Framework for Comprehensive Medical Sentiment Analysis in Twitter Discourse <i>P.C.Sridevi¹⁾ and T.Velmurugan¹⁾</i> ¹⁾ PG and Research Department of Computer Science, D.G. Vaishnav College, India
	8S-6 GPT Empowered: Decoding Public Sentiment Trends on Twitter based COVID-19 Vaccination <i>P.C.Sridevi¹⁾, T.Velmurugan¹⁾, and K. Jayabharathi¹⁾</i> ¹⁾ PG and Research Department of Computer Science, D.G. Vaishnav College, India
12:20 ~	Lunch
13:30 ~	Session 9: Machine Learning for Security and Text analysis Chair: Rock Hyun Choi (DGIST)
	9S-1 Enhancing Hill Cipher Security through Machine-Learned Key Generation <i>Mu. Tirumalai¹⁾ and S. Poornavel²⁾</i> ¹⁾PG & Research Department of Mathematics, IPachaiappa's College, Chennai ²⁾Department of Mathematics, SIMATS School of Engineering, 2Saveetha Institute of Medical and Technical Sciences, Chennai, India.
	9S-2 Cracking the code of Fake News: From PolitiFact Extraction to Machine Learning Mastery <i>Dr. M. P. Sukassini¹⁾ and Dr. R. Anandhi¹⁾</i> ¹⁾ PG and Research Department of Computer Science, D.G. Vaishnav College, India
	9S-3 Impact of AI Driven Conversational Chatbot: Current Advancements and Leading Innovations in Education System <i>G. Kanimozhi¹⁾, K. Bhuvaneswari²⁾, and T. Velmurugan³⁾</i> ¹⁾Assistant Professor, Dept. of Information Technology, Guru Nanak College, Chennai ²⁾Assistant Professor, Dept. of Computer Science, Guru Nanak College, Chennai. ³⁾Associate Professor, PG and Research Dept. of MCA, D.G. Vaishnav College, Chennai.
	9S-4 Text based Emotion Analysis in Social Media Data using Machine Learning techniques <i>B.Jayapradha¹⁾ and T.Velmurugan¹⁾</i> ¹⁾ PG and Research Department of Computer Science, D.G. Vaishnav College, India
	9S-5 Enhancing Sentiment Analysis in Electronic Product Reviews Using Machine Learning Algorithms <i>M. Archana¹⁾, T.Velmurugan¹⁾, and U.Latha¹⁾</i> ¹⁾ PG and Research Department of Computer Science, D.G. Vaishnav College, India

	9S-6 Ecotoxicological Impact Assessment on Donaxincarnatus: An In-depth Exploration of Heavy Metal Bioaccumulation Effects <i>S.Eswari¹⁾, R.Parthiban¹⁾, and P.C.Sathyanarayanan¹⁾</i> ¹⁾ pachaiyappa's college, Chennai. India
14:40 ~	Break
14:50 ~	Session 10: Advanced Monitoring and Analysis Techniques for Power and communication system Chair: Eugen Hyun (DGIST)
	10S-1 Comparative Analysis of Fault Detection Algorithms for MVDC Distribution Systems <i>Nam-Gi Park¹⁾, Jae-In Lee²⁾, Minh-Chau Dinh²⁾, Seok-Ju Lee²⁾, and Minwon Park^{1*)}</i> ¹⁾Dept. of Electrical Engineering, Changwon National University, Changwon, Republic of Korea ²⁾Institute of Mechatronics, Changwon National University, Changwon, Republic of Korea
	10S-2 Design of a RUL Prediction Algorithm for a 2 MW class Wind Turbine Blade and Tower <i>Thi-Tinh Le¹⁾, Minh-Chau Dinh²⁾, Changhyun Kim²⁾, Seok-Ju Lee²⁾, and Minwon Park^{1*)}</i> ¹⁾Dept. of Electrical Engineering, Changwon National University, Changwon, Republic of Korea ²⁾Institute of Mechatronics, Changwon National University, Changwon, Republic of Korea
	10S-3 Analysis of Antenna Characteristics Depending on Angle Between Flat Radar Cover and Radar Antenna <i>Junho Yeo ^{1*)}, Jeong Tak Ryu²⁾, Seungeon Song³⁾, and Jonghun Lee³⁾</i> ¹⁾School of Artificial Intelligence, Daegu University, Gyeongsan, Korea ²⁾Department of Electronics Engineering, Daegu university, Gyeongsan, Korea ³⁾Division of Automotive Technology, Research Institute, DGIST, Dalseong-gun, Daegu, Korea
	10S-4 VIRTULIVING: YOUR DREAM RESIDENCE IN VR <i>Suryawanshi Ansh¹⁾, Vathore Dhamdeep¹⁾, Choudhary Prabha¹⁾, C.Kalpna¹⁾, and Swati Pillai¹⁾</i> ¹⁾ Department of Science(Information Technology), SST College of Arts and Commerce .Ulhasnagar . Maharashtra. India
	10S-5 SMARTLEARN TIMES: API-POWERED EDUCATION HEADLINES APP ¹⁾Chaudhari Mayur¹⁾, Jangale Kuna¹⁾, C.Kalpna¹⁾, Khushbu Purswani¹⁾, and J.C.Purswani¹⁾ ¹⁾ Department of Science(Information Technology), SST College of Arts and Commerce .Ulhasnagar . Maharashtra, India
15:50 ~ 17:00	Session 11: Advanced Applications of Machine Learning and Numerical Methods Chair: Junho Yeo (Daegu Univ.)
	11S-1 Design of an Object Detection Model for an Automatic Ship Unloader System <i>Chi-Hieu Ngo¹⁾, Chang-hyun Kim²⁾, Minh-Chau Dinh²⁾, Seok-Ju Lee²⁾ and Minwon Park^{1*)}</i> ¹⁾Dept. of Electric Engineering, Changwon National University, Changwon, Republic of Korea ²⁾Institute of Mechatronics, Changwon National University, Changwon, Republic of Korea
	11S-2 Data Augmentation for Finger Gesture Recognition using Label Spreading Method <i>Woosoon Jung¹⁾, Jeong Tak Ryu²⁾, Kyuman Jeong³⁾, and Yoosoo Oh^{4*)}</i> ¹⁾The Research Institute for Special Education & Rehabilitation Science, Daegu University, Gyeongsan-si, 38453, Korea ²⁾Dept. of Electronic and Electrical Engineering, Daegu University, Gyeongsan-si, 38453, Korea ^{3, 4)}School of AI, Daegu University, Daegu University, Gyeongsan-si, 38453, Korea
	11S-3 Numerically solving various partial differential equations on non-flat surfaces <i>Yongho Choi¹⁾</i> ¹⁾Dept. of Computer & Information Engineering, Daegu University, Gyeongsan-si, Republic of Korea

International Symposium on Innovation in Information Technology and Application

	11S-4 Smart Timer Application Development using Flutter <i>Sung-Hyeon Jin¹⁾, Kyung-Ae Cha^{2*)}, Jeong-Tak Ryu³⁾ and Kyoung-Ock Park⁴⁾</i> ^{1) 2)} Dept. of Artificial Intelligence, Daegu University, Gyeongsan-si, Korea ³⁾ Dept. of Electric Engineering, Daegu University, Gyeongsan-si, Korea ⁴⁾ Dept. of Elementary Special Education, Daegu University, Gyeongsan-si, Korea
	11S-5 Experimental Performance Analysis of 24 GHz RADAR with Different Radome Materials and Configurations <i>Junho Yeo^{1*)}, Jonghwan Lee²⁾, and Jeong Tak Ryu²⁾</i> ¹⁾ School of Artificial Intelligence, Daegu University, Gyeongsan, Korea ²⁾ Department of Electronics Engineering, Daegu university, Gyeongsan, Korea
15:50 ~ 17:00	Session 12: Intelligent Semiconductor Chair: Kyung Ki Kim (Daegu Univ.)
	12S-1 LightDet: Lightweight Detector for Small Objects <i>Akshay Kumar Sharma¹⁾ and Kyung Ki Kim^{2*)}</i> ^{1) 2)} Dept. of Electronic Engineering, Daegu University, Gyeongsan, 38453, Korea
	12S-2 Nonlinear Analysis of Neuronal Activity with Two Firing Patterns <i>Yoko Uwate¹⁾ and Yoshifumi Nishio¹⁾</i> ¹⁾ Dept. of Electrical and Electronics Engineering, Tokushima University, 2-1 Minami Josanjima Tokushima, 770-8506, JAPAN
	12S-3 An SRAM-Based Transpose Compute-In-Memory Macro Utilizing Programmable Single-Slope SAR ADC <i>Xin Zhang¹⁾, Youngjun Jo¹⁾, and Tony Tae-Hyoung Kim¹⁾</i> ¹⁾ School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore
	12S-4 A hybrid WPT System for Achieving CC/CV Switching <i>Jianxin Yan¹⁾, Wenqi Zhu¹⁾, Yinchun Xie¹⁾, and Hiroo Sekiya¹⁾</i> ¹⁾ Graduate School of Information Science, Chiba University, Chiba, Japan
	12S-5 The Problem of Signal Extraction Based on Sweep Sine for EIS System and Its Solution <i>En-Chi Yang¹⁾ and Shin-Chi Lai^{2*)}</i> ¹⁾ Dept. of Electronic Engineering, National Yunlin University of Science and Technology, Taiwan. ²⁾ Dept. of Automation Engineering, National Formosa University, Yunlin, Taiwan.

January 18 2024	
Time	Content
09:00 ~	Interactive Network
11:00 ~	Committee Meeting
11:30 ~	Closing Ceremony

SESSION 1

Analyzing and Optimizing for Deep Learning
Chair: Yoosoo Oh (Daegu Univ.)

A Study on Performance Analysis of RNN Architecture Using Unbalanced Network Dataset

Donghwoon Kwon¹⁾, Asser Nasser Moustafa¹⁾, and Jeong-Tak Ryu^{2,)}*

¹⁾Dept. of Computer Science and Engineering, North Central College, USA.

²⁾School of Electronic and Communication Engineering, Daegu University, Korea.

E-mail: jryu@daegu.ac.kr

Abstract: This study compares the performance of three Recurrent Neural Network (RNN) model structures targeted at binary classification using the HIKARI-2021 dataset and different hyperparameter tuning methods. Our experimental results reveal that Optuna, an automatic hyperparameter optimization software framework, performs better than a manual hyperparameter tuning method.

Keywords : RNN; GRU; LSTM; deep learning; Optuna; HIKARI;

Introduction

Among various deep learning models that utilize public network traffic datasets [1-2], we pay attention to the HIKARI dataset, which shows an unbalanced characteristic, and the Recurrent Neural Network (RNN) model to address the following research questions:

1. Although the RNN model shows robust performance for sequential data, how does it perform with non-sequential and unbalanced network anomaly data?
2. If the RNN model performs well, which model structure implemented with vanilla RNN units (tanh), Gated Recurrent Units (GRUs), or Long-Short Term Memory (LSTM) units would perform best?
3. Would hyperparameters tuned by the Optuna framework [3] improve model accuracy?

Methodology

Our research model comprises four critical steps: [1]. dataset preprocessing, [2]. model construction, [3]. hyperparameters optimization, and [4]. model training and testing.

1. The HIKARI dataset consists of 555,278 data instances with six distinct labels. As the first step, the entire dataset is categorized into the following two labels: normal and attack, and normal instances come from benign and background labels. Other labels are categorized into attack instances. In addition, the categorized dataset is divided such that 70% served as the training set, 10% served as the validation set, and the remaining 20% as the testing set.
2. With the same model architecture consisting of input, hidden, and output layers, three different model architectures are constructed based on three activation units in a hidden layer, e.g., tanh, GRU, and LSTM. Furthermore, batch normalization and dropout are used to stabilize model training and avoid overfitting, respectively.
3. A meticulous hyperparameter tuning is executed using the Optuna framework. This allows the determination of optimal parameters, e.g., learning rates, dropout values,
4. layer sizes, etc. For instance, specific learning rates such as 1.4050009003792062e-05 for RNN, 1.1431669116903008e-05 for GRU, and 0.001295316945095547 for LSTM are identified through Optuna. Yet, manual hyperparameter tuning is also considered. The Adam optimizer and Cross entropy loss function are employed for model training.

The following Table 1 below summarizes the model architectures.

Table 1. Summary of Model Architectures Based on Hyperparameter Tuning Methods

Hyperparameters Tuning Methods	Models	Input Layer	Hidden Layer	Output Layer	Other Hyperparameters
Manual Tuning	RNN, GRU, and LSTM	Input size: 399,799	# of hidden layers: 1 # of neurons: 128	# of dense layers: 2 # of neurons: 128 and 64, respectively	Batch_size=1024, Batch normalization, dropout=0.5, loss=binary_crossentropy, optimizer = Adam, Learning_rate = 0.001, epochs=20
Optuna	RNN	Input size: 399,799	# of hidden layers: 1 # of neurons: 128	# of dense layers: 2 # of neurons: 128 and 64, respectively	Batch_size=1024, Batch normalization, dropout=0.3, loss=binary_crossentropy, optimizer = Adam, Learning_rate = 1.4050009003792062e-05, epochs=20
	GRU	Input size: 399,799	# of hidden layers: 1 # of neurons: 64	# of dense layers: 2 # of neurons: 64 and 64, respectively	dropout=0.2, Learning_rate = 1.1431669116903008e-05 Batch size, batch normalization, loss function, optimizer, and epochs are same
	LSTM	Input size: 399,799	# of hidden layers: 1 # of neurons: 96	# of dense layers: 2 # of neurons: 96 and 64, respectively	dropout=0.1, Learning_rate = 0.001295316945095547 Batch size, batch normalization, loss function, optimizer, and epochs are same

Experiments

The performance of the three distinct neural network architectures was evaluated based on the test dataset. Table 2 below shows the F -measure of these three models based on the macro average.

Table 2. Experimental Results

Hyperparameters Tuning Method	Models	Precision	Recall	F -Measure
Manual hyperparameters tuning	RNN	0.7301	0.6032	0.6373
	GRU	0.7307	0.5759	0.6064
	LSTM	0.7224	0.6191	0.6515
With Optuna	RNN	0.6837	0.6184	0.6420
	GRU	0.6357	0.8676	0.6656
	LSTM	0.7338	0.6540	0.6838

Discussions

As a result of analyzing the evaluation results of the three model architectures, all models converge well in training, as shown in Figure 1 below. However, model training, especially the RNN and GRU models, through manual hyperparameters tuning shows more stability and higher training performance than using the Optuna framework. Furthermore, with the same number of epochs used for model training, there are approximately 5% and 12% training accuracy differences in both RNN and GRU models, respectively. On the other hand, training the LSTM model through both hyperparameter tuning methods shows an almost identical trend. However, the LSTM model through the Optuna framework shows a slightly better training performance. Model performance with the testing dataset is quite interesting. Both RNN and GRU models through the Optuna framework yield lower training performance but show better testing performance. From this point, we could infer that the RNN and GRU models through the Optuna framework could perform better if more epochs are used for model training because we did not observe overfitting or overshooting issues when training the models in 20 epochs. In addition, the LSTM model through the Optuna framework shows the best performance compared to other models.

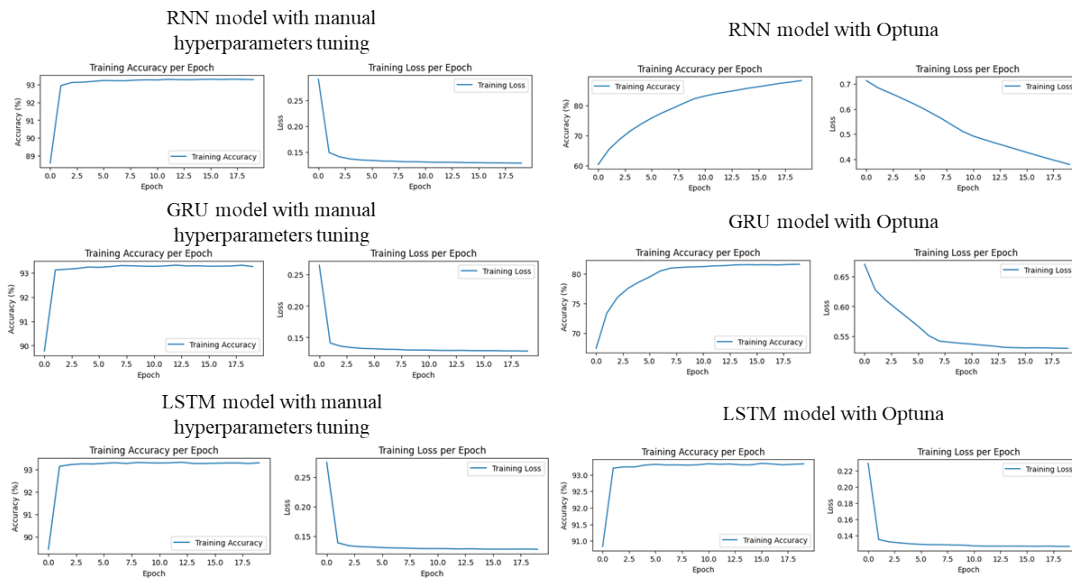


Figure 1. Training accuracies and loss values of three model architectures

Conclusion

This research compares the performance of RNN, GRU, and LSTM model architectures depending on how to tune hyperparameters. Hyperparameter tuning through the Optuna framework tends to show better performance than the manual hyperparameter tuning method. The findings offer a foundation for future exploration, especially focusing on how these model structures show different performances for multi-classification.

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A Study on Prediction of Closing Stock Prices Using a Convolutional Neural Network Model

Even Nybo¹⁾, Joshua Buhr¹⁾, Nicklaus Campanella¹⁾, and Donghwoon Kwon^{1,)}*

¹⁾Dept. of Computer Science and Engineering, North Central College, USA.

E-mail: dkwon@noctrl.edu

Abstract: This paper presents a method for predicting the closing price of individual stocks based on historical data using a 1-dimensional (1D) Convolutional Neural Network (CNN) model. The Yahoo Finance API is used to collect the daily closing prices of Tesla (TSLA), and a window size of 60 days is employed to train the model. Our experimental results with the testing dataset show competitive performance, showing a Mean Square Error (MSE) of 0.0078, and we successfully demonstrate the potential of the 1D CNN model for predicting the closing price of individual stocks.

Keywords : Stock prices; financial forecasting; deep learning; CNN; time series analysis; stock prediction

Introduction

Predicting stock prices accurately is one of the most challenging tasks in financial forecasting due to the unpredictable nature of financial markets. Many factors, such as economic events, company news, and global political instability, can influence stock prices. Predicting the effect of these factors on stock prices is an important research area in finance. One approach to predicting stock prices uses deep learning models [1-2], and as the first phase in this research, we employ a Convolutional Neural Network (CNN) model to predict the closing price of the Tesla (TSLA) stock based on its historical data. Through this research, we evaluate model performance by comparing it with the actual prices.

Methodology

Tesla's historical daily closing prices are collected using the Yahoo Finance API. A window size of 60 days is employed, and the dataset is scaled using the Min Max Scaler function. The dataset is then split into training and testing, with the last 365 days reserved for testing.

The employed deep learning model is the one-dimensional CNN model. In this model, the input to the model is a sequence of closing prices over the past window size days (60), and the output is a single predicted closing price. The following describes a model structure, and Figure 1 below depicts its structure.

- One 1D convolutional layer with 16 filters, kernel size of 3, stride of 1, and padding of 1.
- The convolutional layer is followed by a Rectified Linear Unit (ReLU) activation function.
- One max pooling layer with a kernel size of 2 and stride of 2.
- Two Fully Connected (FC) layers. The first FC layer is composed of 32 units and the ReLU activation function, and the second FC layer has one unit for a single output.

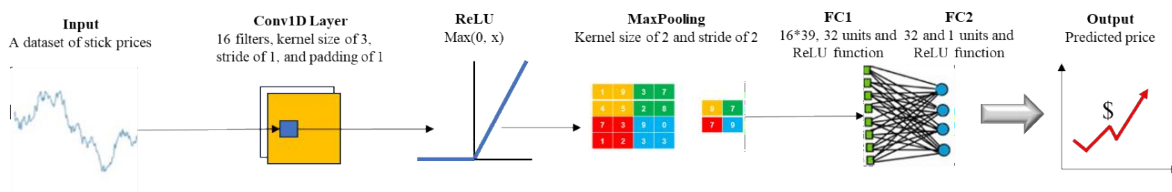


Figure 1. CNN Model Structure

Experimental Results

The 1D CNN model is trained on the training set for 2,000 epochs with a learning rate of $1e-3$ using the MSE loss function and the Adam optimizer. We achieve an MSE of 0.0078, and the following Figures 2 (a) and (b) below illustrate training loss values and training accuracy.

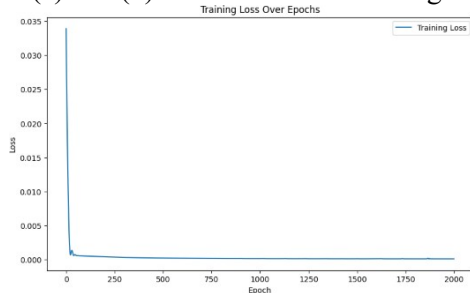


Figure 2. (a) Training Loss Values

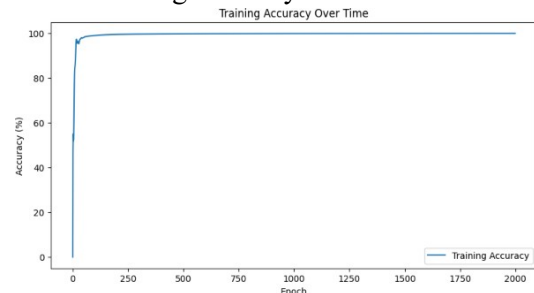


Figure 2. (b) Training Accuracy

Discussions

To further analyze the model performance, the predicted and actual prices for the testing set are plotted using Matplotlib, shown in Figure 3 (a) below. This reveals that the model tends to capture the general trend of stock prices. However, even if the model is able to predict the changes in the Tesla stock, it struggles to predict the spiked highs and the larger drops. Moreover, some deviations from the actual costs are observed, which may be caused by market fluctuations and unforeseen events affecting stock prices.

In addition, the impact of different hyperparameters on the model performance, including the learning rate and number of epochs, is explored. We observe that increasing the learning rate beyond $1e-3$ does not improve the model performance, suggesting that a lower learning rate is more effective for this task. Additionally, training the model with over 2,000 epochs does not significantly improve its performance and may cause model overfitting.

With the first experimental results tested with the Tesla stock, another question of how accurately the CNN model is able to predict the Bitcoin market is raised. As shown in Figure 3 (b) below, the CNN model is able to predict the trends from about the 75th day, but every prediction from 0 to 75 days shows inaccurate patterns skewed to the right.



Figure 3. (a) Tesla Stock Prediction

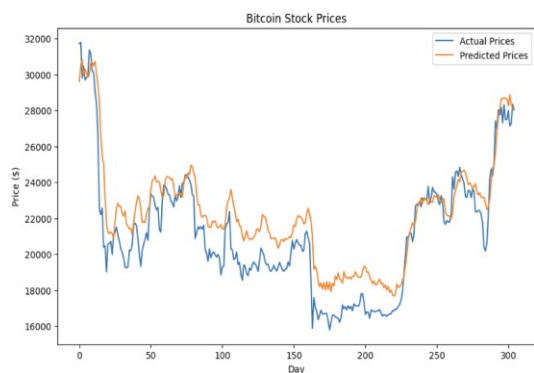


Figure 3. (b) Bitcoin Prediction

Conclusion

This research presents a 1D CNN model for predicting the closing price of individual stocks based on historical data. The results show that the model can capture the general trend of the stock prices, although there are some deviations from the actual costs. These findings suggest that a 1D CNN model can effectively predict stock prices, but further experiments are needed to optimize the model performance and evaluate its generalizability to other stocks and market conditions. Future studies could investigate other types of neural network models, such as Multi-Layer Perceptron (MLP), Recurrent Neural Network (RNN), or Long Short Term Memory (LSTM) models, for predicting stock prices.

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Biography

Even Myren Nybø is pursuing a B.S. degree in computer science and a minor in Economics from North Central College expecting graduate in 2024.

Joshua Michael Buhr is pursuing a B.S. degree in computer science from North Central College, expecting to graduate in 2024.

Nicklaus Salvatore Campanella is pursuing a B.S. degree in computer science and a minor in Economics from North Central College, expecting to graduate in 2024.

Dr. Donghwoon Kwon is an assistant professor in the Department of Computer Science and Engineering at North Central College. His research interests are machine learning and deep learning, network anomaly detection, software engineering, database management, and IT / IS project management. He has published numerous peer-reviewed journals and conference proceedings.

Feasibility of Transfer Learning for Network Anomaly Detection

Donghwoon Kwon^{1,}, Naveen Chennaipalem², Junekyoung Lee³, and Jinoh Kim²*

¹Dept. of Computer Science and Engineering, North Central College, USA.

²Computer Science Department, Texas A&M University, USA.

³NaonWorks Inc, Korea.

E-mail: dkwon@noctrl.edu

Abstract: Identifying malicious communication activities is one of the critical requirements in network operations and management. A non-trivial challenge for network anomaly detection is the limited availability of traffic data, often with no annotated class information. In this study, we assess the applicability of *cross-domain* transfer learning for network anomaly detection and share our initial results made from our experiments performed for evaluating transfer learning performance with three machine learning methods. The key observation is that simply applying transfer learning may not produce acceptable performance, while we observed that utilizing cross-domain datasets has the potential to enhance the classification performance, which signals the need for further investigation of the impact of transfer learning for network traffic analysis.

Keywords : Transfer learning, network anomaly detection, machine learning

Introduction

A cybersecurity area is an evolving domain where threats and vulnerabilities constantly test the robustness of system defenses. With the expansion of connected devices and the broadening of digital networks worldwide, ensuring these systems' security and reliability has become more critical and challenging. To secure the network, identifying malicious communication activities is one of the key requirements, and in that sense, monitoring and analyzing network traffic should be core tasks in network operations and management.

While essential, a non-trivial challenge for network traffic analysis is the scarcity of traffic data. Even worse, many traffic datasets contain no annotated information, and only a few datasets provide the class label information (e.g., NSL-KDD, UNSW-NB15, CICIDS 2017/2018, and HIKARI-2021). Additionally, individual datasets may be confined in terms of traffic diversity due to data collection environments and methodologies. For those reasons, *transfer learning* has been considered for traffic analysis; however, previous studies have been limited to the outdated dataset (NSL-KDD) that may not represent today's traffic characteristics [1], cross-attack learning (i.e., creating a model from one attack type to detect another attack class) [2], and the use of pre-trained deep learning models with no cross-domain learning among different datasets [3].

In this study, we assess the applicability of *cross-domain* transfer learning for network traffic analysis, i.e., utilizing one dataset for creating a model (*base set*) to analyze another dataset (*target set*). We particularly focus on network anomaly detection that discriminates malicious instances from benign samples. This is an ongoing study toward the development of cross-domain transfer learning mechanisms, and we share the initial results and observations made from our experiments. We focus on two datasets, CICIDS-2018 and HIKARI-2021 ("CICIDS" and "HIKARI" in short, respectively), based on the observation that the two datasets provide a sufficient number of features commonly found in both datasets (53 common features). We then evaluate the transfer learning performance with three machine learning methods, i.e., Random Forest (RF), Extreme Gradient Boosting (XGB), and Multi-Layer Perceptron (MLP).

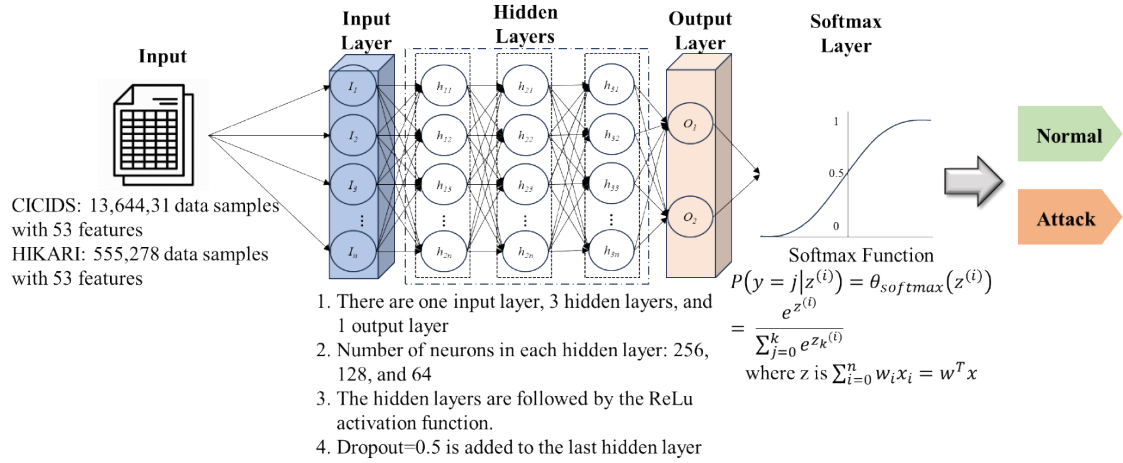
Methodology

As the first step, we compare two datasets and identify a common set of features. Based on 53 identified features, four labels in the CICIDS (Benign, Bot, Dos attacks-SlowHTTPTest, and Dosattacks-Hulk) are classified into normal or one of the attack labels, while HIKARI defines six types (Benign,

Background, BruteForce, BruteForce-XML, Probing, and XMRIGCC CryptoMiner). The entire samples in both datasets are adopted, and the shape of each dataset is as follows: CICIDS has a shape of 1,364,431 by 53, and HIKARI has a shape of 555,278 by 53. Note that both datasets are unbalanced with a relatively small number of attack instances than normal: CICIDS has a ratio of 3.7 to 1, and HIKARI has a ratio of 13.7 to 1 for normal vs. non- normal. We consider the following four scenarios to measure transfer learning performance:

1. Case I: Train the classifier with CICIDS and test it with HIKARI.
2. Case II: Train the classifier with HIKARI and test it with CICIDS.
3. Case III: Train the classifier with the mixture of CICIDS and HIKARI and test it with HIKARI.
4. Case IV: Train the classifier with the mixture of CICIDS and HIKARI and test it with CICIDS.

The RF, XGB, and MLP models are employed with the dataset combinations. The default configuration of the RF and XGB models provided by the Python `scikit-learn` library is adopted (without intensive optimization processes), while we implement a neural network for MLP configured with three hidden layers, as illustrated in Figure 1.



Experiments

We report the performance of transfer learning with the aforementioned classifiers, with the metric of F-measure[1] to consider the class imbalance in the datasets. Table 1 provides the performance measured under the different settings (Case I-IV) with non-transfer learning results. In the case of non-transfer learning, HIKARI shows quite poor performance, with less than 63% of F-Measure, while CICIDS shows over 93%, indicating that analyzing HIKARI is much more challenging than CICIDS. For Case I and II (cross-domain transfer learning), the result shows that the classifiers perform poorly with unacceptable performance (less than 50%). Although not shown in Table 1, we observed that the classifiers are not able to classify any attack instances as anomalies. Cases III and IV show the use of both datasets in the training phase. While the result shows almost the same performance as Case I and II, one interesting observation is that MLP yields a promising result over 98% for Case IV: While MLP shows 93.4% with the CICIDS training set only, it improves the performance to 98.0% with the employment of both CICIDS and HIKARI for training, suggesting the potential of transfer learning for network anomaly detection.

Table 1. Experimental results (Non-transfer learning and transfer learning cases)

Category	Datasets	Models	F-Measure
Non-transfer learning	CICIDS: 80% of training and 20% of testing	RF	0.9995
		XGB	0.9998
		MLP	0.9348
	HIKARI: 80% of training and 20% of testing	RF	0.5243
		XGB	0.6223

Transferlearning	Case I: Training with CICIDS and testing with HIKARI	MLP	0.4824
		RF	0.4824
		XGB	0.4824
		MLP	0.4797
	Case II: Training with HIKARI and testing with CICIDS	RF	0.4405
		XGB	0.4405
		MLP	0.4405
	Case III: Training with the mixture of CICIDS and HIKARI and testing with HIKARI	RF	0.4824
		XGB	0.4824
		MLP	0.4806
	Case IV: Training with the mixture of CICIDS and HIKARI and testing with CICIDS	RF	0.4405
		XGB	0.4405
		MLP	0.9802

Conclusion

In this study, we investigated the applicability of transfer learning for network anomaly detection. From our initial experimental results, the critical observation is that simply applying transfer learning may not produce acceptable performance (Case I and II), while we observed that utilizing cross-domain datasets has the potential to enhance the classification performance (MLP in Case IV compared to the result in Case I). A possibility to explain this is that using the cross-domain data would give additional hints for discriminating two classes when creating a neural network model.

From our initial findings, we plan to extend our investigation to maximize the benefit of transfer learning, which includes feature selection and extraction to identify an efficient set of features, one-class classification for better representing benign samples, in addition to an exploration of other neural network models with the optimization and extensive experiments.

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Active and Passive Learning Approaches in Computer-mediated Platform do not significantly differ in e-Learning Gains

Ethan Chav Isaac P. Sumalinog¹⁾, and Demelo M. Lao^{1,)}*

¹⁾Department of Computer Science, College of Science, University of the Philippines Cebu, Philippines.

E-mail: dmlao1@up.edu.ph

Abstract: Learning a computer programming language can be challenging for students who have no programming background. Oftentimes, this situation leads to a steep learning curve for the student, and in worst case, may trigger the decision not to pursue further a computer science (CS) profession. Hence, this paper evaluated two (2) e-learning approaches to enhance the learning experience of a programming language in a computer-mediated platform. For this purpose, two (2) versions of a web application that teach introductory Python were developed, with one employing the active while another utilizing the passive learning methods following the DOLA framework, respectively. In setting up the experiment, the study applied a mixed-method research design. For the quantitative part, the study utilized a Pre- and Post-tests experimental design to assess for the learning outcomes, while the follow-up qualitative portion employed thematic analysis to gain insights from participants' learning experiences. The Learning Object Review Instrument (LORI) was used to evaluate the web application's effectiveness as a pedagogical tool, in which also the Cronbach's alpha was calculated to test for internal consistency. Although the results showed significant differences between the pre- and post-test quiz scores for each of the e-learning methods, there is no detected statistical difference in the overall learning gains of post-test quiz scores between active and passive e-learning methods. On the other hand, the qualitative findings lend support to the effectiveness of both e-learning approaches as pedagogical tool, while at the same time providing a better learning experience of introductory Python using the developed web apps as evidenced by feedback themes commonly identified in both versions such as 'learning experience' (41.5% of responses) and 'user interface and design' (26.4% of responses), respectively. These findings contribute to the assessment for effective learning methods in teaching of a programming language at the introductory level in a computer-mediated platform and the implications towards instructional design and learning platform development.

Keywords : e-learning, active learning, passive learning, active vs passive learning, Python tutorial, computer science education, DOLA framework

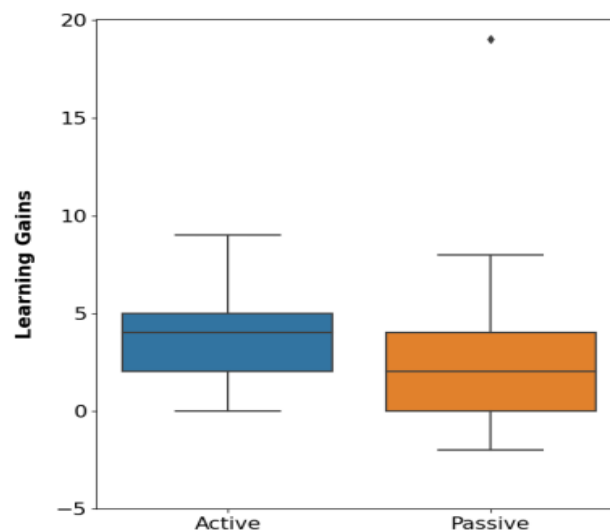


Figure 1. Distribution of Learning Gains (i.e., the difference between Post- and Pre-tests Quiz).

Learning Methods

Scores for Active (left boxplot, $p\text{-value} < 0.05$) and Passive (right boxplot, $p\text{-value} < 0.05$) e-Learning Approaches. The active learning mode portrays negative skewness which implies more positive learning observed than the mean-average. While that of passive learning mode exhibits symmetric distribution, but with a lower mean-average of positive learning and with a few e-learning instances resulted to negative learning, i.e., a lower post-test quiz score than that of the pre-test. Overall, the mean comparison of learning gains between active and passive e-learning approaches yields a statistically not significant result, which suggests that either of the two (2) e-learning approaches can effect learning with the former having a higher learning gain or learning improvement than the latter on the average.

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A Deep Learning Framework for Protecting Personal Computers from Unauthorized Mobile Screen Recordings

Ihsan Ullah¹⁾, Rock Hyun Choi¹⁾, and Hyunki Lee^{1,)}*

¹⁾Division of Intelligent Robotics, DGIST, Korea.

E-mail: ihsankhan / hkleee @dgist.ac.kr

Abstract: Unauthorized mobile screen recordings pose a serious threat to the security and privacy of personal computers in today's digital era. Nevertheless, there is a lack of prior research conducted to address this particular challenge. To tackle this challenge, we present a deep learning approach that effectively manipulates the channels in the temporal dimension[1] in video frames. The channel manipulation in temporal dimension allows the mixing of feature maps from adjacent frames with the current frame, resulting in improved mobile action recognition in videos. Moreover, the Mobilenetv2[2] architecture incorporates the channel shifting module after the bypass connections as shown in Fig.1(a). In addition, the proposed method employs the Mobilenetv2 architecture, resulting in improved computational efficiency for frame processing. Consequently, it is well-suited for real-time recognition of unauthorized mobile screen recording, with low latency.

Experimental Setup: To evaluate the efficacy of our proposed method, we conducted experiments on a in-house dataset designed for mobile action recognition. The dataset comprises recordings of 16 individuals, with each person performing both normal and abnormal actions, resulting in a total of 32 videos. To enhance the dataset, we augmented these videos, ultimately yielding 220 samples. In our experimental setup, we divided the augmented dataset into two separate sets: a training set comprising 140 videos and a testing set comprising 80 videos.

Results: To validate the performance of our proposed method, we employed widely-used evaluation metrics, namely precision, recall, and F1-Score. Fig. 1(b) depicts the precision, recall, and F1-Scores obtained for both the normal and abnormal classes. For the normal class, which consists of 38 videos, our method achieved impressive results with 97% precision, 93% recall, and an overall F1-Score of 95% on the test set. Similarly, for the abnormal class, which includes 42 videos, our method attained high accuracy scores, achieving 93% precision, 97% recall, and F1-Score of 95% on the test set. These results indicate the effectiveness and robustness of our proposed method in accurately distinguishing between normal and abnormal actions in mobile videos. The high precision and recall values, along with the balanced F1-Scores, demonstrate the reliability of our approach, thereby validating its potential applicability in mobile action recognition tasks.

Additionally, to gain insight into the interpretability of our approach, we conducted qualitative analysis and presented the results in Fig. 1(c) using LayerCam[3]. In the case of the normal class (representing no mobile phone), the resulting heatmaps indicated that the learned features by our method were primarily activated at the arm regions, reflecting its emphasis on capturing actions that do not involve mobile phones. Likewise, for the abnormal class (indicating the presence of a mobile phone), the heatmaps were activated around the camera region of the mobile device, highlighting the effectiveness of our method in identifying actions involving mobile phones. This qualitative analysis reinforces the validity and interpretability of our proposed approach and offers valuable insight into its feature learning capabilities.

Keywords : Deep Learning, Action Recognition, Personal Computer Security.

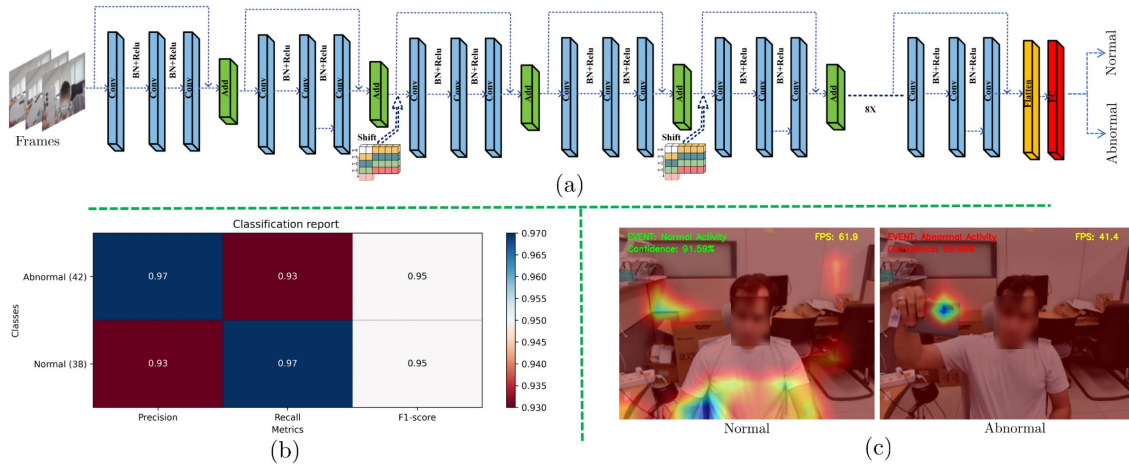


Fig. 1. Our proposed framework for detecting screen recording actions using a mobile phone (Fig. 1a) involves preprocessing the frames and passing them through the Mobilenet-v2 architecture with a module for feature shifting. Fig. 1b depicts the quantitative results for both normal and abnormal classes, whereas Fig. 1c demonstrates the qualitative results for these classes.

Acknowledgment

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Automatic Data Transformation System for Regressor and Classifier

Sehyun Myeong ¹⁾ and Yoosoo Oh ^{2,*)}

1,2) School of AI, Daegu University, Korea.

E-mail: yoosoo.oh@daegu.ac.kr

Abstract: In this paper, we propose an automatic data transformation system for regressor and classifier in machine learning. Also, the proposed system applies inputted data to classification and regression machine learning algorithms without considering the attributes of the inputted data. The proposed system performs well even when discrete data to regressor or continuous data to classifier. Comprehensively, when applied to any algorithm, the proposed system correctly predicts outcomes regardless of inputted data properties.

Keywords: Discrete Data; Continuous Data; Regressor; Classifier; Machine Learning

Introduction

The low code method partially completes the confused aspects of machine learning to effortlessly access unfamiliar machine learning coding, such as selecting data attributes. Besides, a low code-based machine learning method enables a non-expert (a novice or developer in other fields) to use machine learning easily without expertise [1]. In this paper, we propose an automatic data transformation system for regressor and classifier in machine learning. The proposed system automatically converts data according to discrete and continuous attributes. In other words, the proposed system transforms discrete into continuous data and vice versa by using line spacing and quantiles methods. Accordingly, the proposed system enables non-experts in machine learning to achieve highly accurate predictions even when applying algorithms that do not match the attributes of the inputted data.

Proposed System

The proposed system consists of a User Input, Auto Data Converter, Data Attribute Evaluator, Algorithm Selector, Predicted Result Evaluator, and Evaluation Indexer, as shown in Figure 1. Our system converts the original data input to the target data's attributes whether they are discrete or continuous. Our system automatically transforms inputted data into an appropriate format for machine learning algorithms. In case of discrete data input, our system transforms by mapping even spacing data into uniform continuous data. In case of continuous data input, our system transforms by dividing continuous data into unique quantiles.

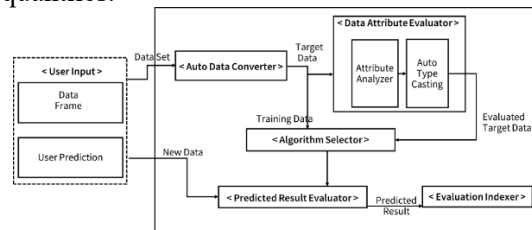


Figure 1. Proposed System Diagram

We applied several algorithms, such as SVR, KNeighborsRegressor, and LinearRegression as regressors and SVC(Linear kernel), SVC(RBF kernel), LinearSVC, KNeighborsClassifier, RadiusNeighborsClassifier, MLPClassifier, VotingClassifier, RandomForestClassifier, GradientBoostingClassifier as classifiers. For the evaluation, we experimented a performance test with two datasets('Laliga player stats'[2], and 'winequalityN'[3]). As a result, the proposed system showed about 86%, 85% high performance on the classification accuracy and a 0.18, 0.7 low error rate on the regression MAE in.

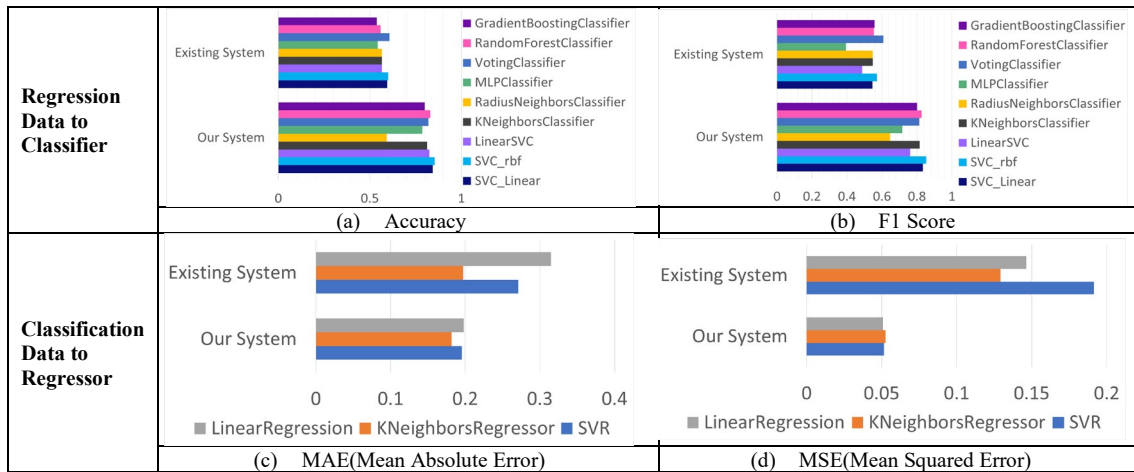


Figure 2. The proposed system can apply classification and regression algorithms to generate learning models regardless of the attributes of the inputted data.

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SESSION 2
Machine Learning and Applications
Chair: Hyunki Lee (DGIST)

Securing Truth: Integrated Deepfake Detection with Advanced Fusion Techniques

Javokhir Jumaboev¹⁾ and Mohamed Uvaze Ahamed Ayoobkhan^{2,)}*

^{1,2)} Department of Computer Science, New Uzbekistan University, Uzbekistan.

E-mail: 2110025@newuu.uz / m.uvaze@newuu.uz

Abstract: This paper presents a collaborative and comprehensive approach to addressing the escalating threat of deepfakes, leveraging diverse methodologies within the realms of deep learning, biometric forensics, and innovative image forgery detection techniques. Acknowledging the challenges faced by traditional convolutional neural networks (CNNs) in cross-dataset evaluations and their dependency on large training datasets, our research focuses on evaluating the effectiveness of deep face recognition in detecting deepfakes. In tandem, a biometric-based forensic technique is introduced, combining static facial recognition with temporal, behavioral biometrics. This approach proves efficacious across large-scale video datasets and in-the-wild deep fakes. The issue of synthesizing photo-realistic fake images through generative adversarial networks (GANs) is addressed with a deep learning-based approach utilizing contrastive loss, surpassing conventional image forgery detectors. Furthermore, a method rooted in face recognition is proposed for precise detection of DeepFake digital images. Leveraging Facenet, this approach extracts face image feature vectors, allowing machine learning algorithms to achieve binary classification of real and fake face images. Collectively, these collaborative methodologies offer a robust and versatile strategy for detecting deepfakes, combining the strengths of deep learning, biometric forensics, and innovative image forgery detection techniques. The proposed approach aims to enhance accuracy and efficiency in identifying synthetic media, safeguarding against the potential threats posed by deepfake technology.

Keywords: Deepfake Detection, Deep Learning, Biometric Forensics, Image Forgery, Fusion Techniques, Cybersecurity.

Extended Abstract

As technology advances, so does the risk of encountering highly convincing and deceptive content known as deepfakes [1]. These sophisticated manipulations, generated using deep learning techniques, pose serious threats to various aspects of our lives, including privacy, national security, and the trustworthiness of information in democratic processes [2]. Recognizing the urgency of this issue, our research seeks to develop a more effective and comprehensive solution for detecting deepfakes with the investigation phases as shown in figure 1.

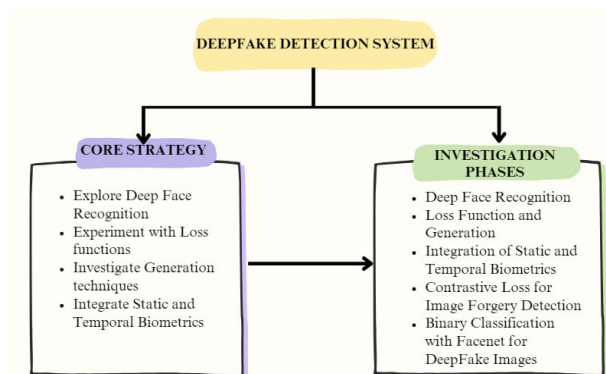


Figure 1. Core strategies and Phases of the proposed method.

Current methods for spotting deepfakes face challenges, particularly in terms of accuracy and adaptability [3]. In response, our approach combines the strengths of advanced technologies, specifically deep learning, biometric forensics, and image forgery detection. We aim to create a more

robust system that surpasses the limitations of traditional methods, which often rely on binary classification and specific datasets for training.

At the core of our strategy is an exploration of how well deep face recognition can identify deepfakes. By experimenting with various loss functions and generation techniques, we hope to improve upon the shortcomings of common methods like convolutional neural networks (CNNs) [4]. Additionally, we introduce a new method that merges static facial recognition with temporal, behavioral biometrics, offering a more flexible approach that can adapt to real-world scenarios.

Our investigation also delves into image forgery detection using contrastive loss, a technique grounded in deep learning that proves superior to traditional detectors in identifying artificially generated fake images. Furthermore, we introduce a unique approach to detecting DeepFake digital images by utilizing Facenet in a binary classification framework, eliminating the need for extensive fake data during training [5].

Through this collaborative fusion of methodologies, our research aims to contribute to the ongoing efforts in countering deepfake threats. By addressing current limitations and proposing innovative solutions rooted in accessible language, we aspire to make a meaningful impact in safeguarding the trustworthiness of visual content in the face of increasingly sophisticated synthetic media.

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Hesitation Analysis and Score Function Design on Intuitionistic Fuzzy Set Data

Sanghyuk Lee^{1,} and Yuliya Durova¹⁾*

¹⁾Department of Computer Science. New Uzbekistan University, Uzbekistan.

E-mail: l.sanghyuk@newuu.uz / y.durova@newuu.uz

Abstract: Score function is designed by the consideration of Intuitionistic Fuzzy Sets (IFSs) characteristic. On the necessity from more generalized data, the research on IFSs is necessary to the decision making problem. Existing researches on the score function design with IFSs include additional accuracy function to complete decision. In this regard, effective score function has been needed to carry decision. More accurate score function is designed in this paper. And the calculation results show the score function usefulness.

Keywords: decision making; score function; intuitionistic fuzzy set

Introduction

Decision making problem solving with vague data has been emphasized by numerous researchers [1-5]. It has advantage on the data flexibility, and actual data application view points. However, it also had some limitation on the objective data processing and membership criterion. Specifically, on the treatment on hesitation, so it invoked the decision accuracy problem in the existing research [1,2].

In this regard, research on hesitation related with decision making is necessary. First, hesitation analysis on the membership and non-membership function will be addressed. With the information we have, effective score function is applied to the decision making problem. To be more general objective, multi-criteria decision problem is considered.

Paper is organized as follows; fundamental analysis on hesitation is followed in the next section. Score function is proposed and proved by the consideration of hesitation. And we will discuss how the score function apply to the decision problem.

Methodology

A. Intuitionistic Fuzzy Sets (IFSs)

Since Zadeh introduction, fuzzy sets (FSs) membership and non-membership functions are defined as; $\mu A(x)$ and $\nu A(x)$ on FSs. An A in FSs, $\mu A(x)$ and $\nu A(x)$ are belong to the value inbetween $[0, 1]$ over the universe of discourse $x \in X$. From the specific relation in IFSs, $\pi A(x) = 1 - \mu A(x) - \nu A(x)$ is defined as the hesitation degree by Atanassov [6]. Together with $\mu A(x)$ and $\nu A(x)$, the following basic definition is illustrated. IFSs is defined over the universe of discourse $X = \{x_1, x_2, \dots, x_n\}$ as follows:

$$V = \{(x, \mu I(x), \nu I(x)) | x \in X, \mu I(x) \in [0,1], \nu I(x) \in [0,1], 0 \leq \mu I(x) + \nu I(x) \leq 1\}$$

where, $\mu I(x)$ and $\nu I(x)$ denote a membership function and non-membership function of x in X , respectively.

Furthermore, if $\mu I(x) + \nu I(x) = 1$, IFSs V is considered as a standard FSs. It is clear that hesitation satisfies one as $\mu I(x) + \nu I(x) \rightarrow 0$, that is, it approaches to origin. Pure FSs means that it has no hesitation, $\mu I(x) + \nu I(x) = 1$. Relations between membership degree and non-membership degree are defined by positive hesitation; $0 \leq \mu I(x) + \nu I(x) \leq 1$. Negative hesitation is also investigated in our existing research [7].

Hesitation inside of Membership Function

Consider the component in the graphical representation in the existing research [6],

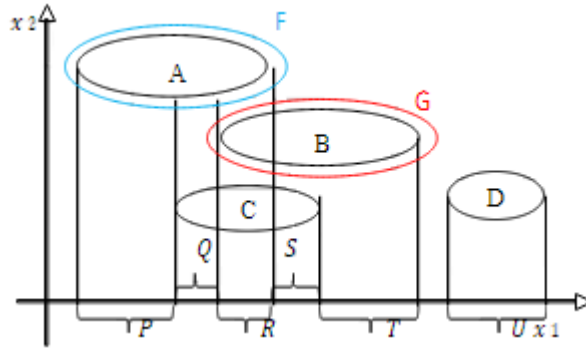


Figure 1. Information distribution in two dimensional space

four information types are illustrated in Fig. 1 [6], and membership and non-membership degree design are obtained by considering $A \subset F$, $B \subset G$. The information inclusion relation, $A \subset F$, $B \subset G$, $F \cap G = \emptyset$, and $F \cup G \subset E$ for the universe of discourse $E = A \cup B \cup C \cup D$. Two information case, F and G , $\mu F(x) + \nu F(x) \leq 1$ and $\mu G(x) + \nu G(x) \leq 1$ are satisfied. Atanassov derived membership and non-membership functions $\mu F(x)$ and $\nu F(x)$ on IFSs.

- **Proposition 1.** For the two information of F and G in $E = A \cup B \cup C \cup D$, membership and non-membership illustrate following property; for $x \in E$, $\mu G(x) = \nu F(x)$ and $\mu F(x) = \nu G(x)$.

Hence, hesitation $\pi G(x) = 1 - \mu G(x) - \nu G(x)$ shows the same value with $\pi F(x)$. Furthermore, it has big advantage to recognize non-membership function from the comparable membership function.

- **Proposition 2.** Hesitation on IFSs are derived from the additional information besides of two corresponding data.

Evaluation

B. Score Function for the Decision Making

For A and B in IFSs, existing score functions and decision-making strategies are recalled, and the operator ' $<$ ' shows the preference of different IFSs, $A < B$ stands the score of A is less than that of B , which means we do prefer B than A .

The score function $SC(A)$ was proposed by Chen and Tan [1], and it was expressed as follows:

$$SC(A) = \mu A(x) - \nu A(x) \quad (1)$$

where $SC(A)$ exists over $[-1, 1]$. When $S(A) < S(B)$ is satisfied, it is indicated by the preference $A < B$.

However, (7) faces the difficulty in the decision when it satisfies $S(A) = S(B)$. In order to overcome this difficulty, an accuracy function $H(A)$ was proposed by Hong and Choi [4]:

$$H(A) = \mu A(x) + \nu A(x) \quad (2)$$

where $H(A) \in [0, 1]$.

Large $H(A)$ implies more information is clarified, then it can be the supplement property to make decision.

However, it still insufficient to consider the hesitation property [3].

A score function $SL(A)$ by Liu and Wang was also proposed by the consideration of hesitation [5]:

$$SL(A) = \mu A(x) + \mu A(x)\pi A(x).$$

We have proposed a new preference scale function in IFSs for decision-making with IFSs, which is based on a pair of independent two-dimensional vectors composed of the membership and non-membership degrees of an IFS; $\mu(x)$ and $\nu(x)$. The preference scale dependency on the difference between membership and non-membership degrees is emphasized in Corollary 1. Compared with the existing research, the proposed score function showed clear decision results with the help of strict monotonic properties.

Acknowledgment

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Online Machine Learning: Adapting to Dynamic Data Streams in Real Time

Diyorbek Usmanov¹⁾

¹⁾Department of Computer Science, New Uzbekistan University, Uzbekistan.

E-mail: 2110004@newuu.uz

Abstract: Online machine learning, also referred to as incremental or streaming machine learning, is a specialized field focused on processing data in a sequential, real-time manner. This paradigm involves continuously updating models as new data arrives, facilitating dynamic learning and adaptation. Striking a delicate balance between leveraging the most recent information and retaining knowledge from previous data is a key challenge in online machine learning. This abstract offers an insightful overview of the field's significance in managing dynamic and evolving data streams. The importance of algorithms capable of incremental learning, adapting to changing patterns, and making real-time predictions or decisions is explored. Online machine learning's applications span diverse domains such as finance, e-commerce, social media analysis, and sensor networks, addressing scenarios where continuous data influx necessitates swift decision-making. Its capabilities extend to anomaly detection, predictive analytics, recommendation systems, and dynamic pricing. The abstract delves into the challenges associated with online machine learning, including the intricate trade-off between model complexity and computational efficiency. Furthermore, it emphasizes the need for techniques to handle concept drift, limited resources, and data quality issues. In conclusion, online machine learning provides a potent framework for managing streaming data and facilitating real-time decision-making. As a continuously evolving research area, ongoing efforts are dedicated to developing efficient algorithms and techniques that can effectively address the unique characteristics and challenges posed by sequential data.

Keywords: Online Machine Learning, Dynamic Data Streams, Real-time Learning, Incremental Algorithms, Concept Drift, Sequential Data.

Extended Abstract

In today's world of generating massive amounts of data, it's crucial to keep up with constant changes and learn from incoming data streams [1]. Traditional machine learning methods were designed for static datasets, where all the data is available at once. However, these methods struggle to handle real-time updates and changing data [2]. This is where online learning algorithms come in. They're specifically created to handle data that comes in sequentially, allowing models to adapt and improve predictions as new data points arrive. This makes them well-suited for dynamic environments where the nature of the data changes over time. Figure 1 shows the process of Machine learning in the dynamic environment.

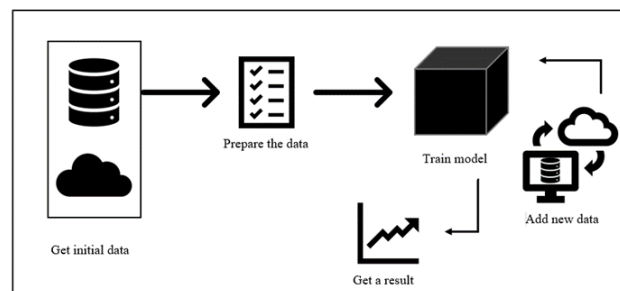


Figure 1. Machine learning process

This research paper aims to explore and understand online learning algorithms tailored for real-time data streams. Three main areas will be covered:

- **Implementation of Select Algorithms:** Explanation and implementation of specific online learning algorithms, such as Adaptive KNN, Online K-Means, and Passive-Aggressive Algorithms. These algorithms are chosen for their popularity, performance, and diverse techniques [3]. The focus is on making these algorithms adaptable to real-time learning scenarios.
- **Analysis of Algorithmic Approaches:** In-depth examination of how different online learning algorithms perform. This includes looking at their strengths, limitations, and trade-offs under various conditions and with different datasets. The goal is to gain insights into their effectiveness in different situations.
- **Practical Applications Across Domains:** Exploration of how online learning algorithms, specifically Adaptive KNN, Online K-Means, and Passive-Aggressive Algorithms, are used in real-world situations. Examples will be highlighted in areas like online advertising, recommendation systems, fraud detection, and anomaly detection [4]. The aim is to emphasize the practical benefits and implications of using these algorithms in different real-world scenarios.

The thorough analysis of algorithmic approaches, considering their strengths, limitations, and trade-offs, provides valuable insights into their performance under diverse conditions and with different datasets. Moreover, the exploration of practical applications across domains, including online advertising, recommendation systems, fraud detection, and anomaly detection, highlights the versatility and real-world significance of these algorithms. In essence, this research contributes to the ongoing discourse on the importance of online learning algorithms in adapting to the demands of real-time data streams. This paper provides a comprehensive perspective on the role and impact of online learning algorithms in contemporary machine learning practices.

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Method to reduce false-positive errors using discretization and short-term filter for mobile device detection

Rock Hyun Choi¹⁾ and Hyunki Lee^{1,*)}

¹⁾Division of Intelligent Robotics, DGIST, Korea.

E-mail: choimosi@dgist.ac.kr / hklee@dgist.ac.kr

Abstract: In modern society, the use of mobile devices is considered an essential tool, deeply rooted in many aspects of our lives[1]. These devices provide us with convenience, but also cause various problems. Among them, the issue of business secret leakage is particularly noteworthy. Such leakage poses a serious threat to the security of the company, and as a result, it can have a negative impact on the stability and growth of the company[2]. Therefore, it is important to raise awareness of these issues related to the use of mobile devices and to establish appropriate response measures. Various papers are conducting related research, and the method of using SSD and Faster-RCNN series deep learning models is mainly dealt with recently[1]. In this study, we researched a method to reduce False-positive in order to find mobile devices in the video with higher accuracy. For preprocessing, we used Discretization[4-5] to determine one of the hyperparameters of YoloV8[3], the Confidence Score, and then assumed that it takes about 1 second to take a picture using a mobile device[6]. Using that assumption, we used a Short-term filter to remove things that look similar to mobile devices for a short time due to the movement of people in the video, thereby reducing the errors found. According to the experimental results, we were able to significantly reduce errors compared to using the standard YOLOv8.

Keywords: Object detection, Mobile device, Security Threats

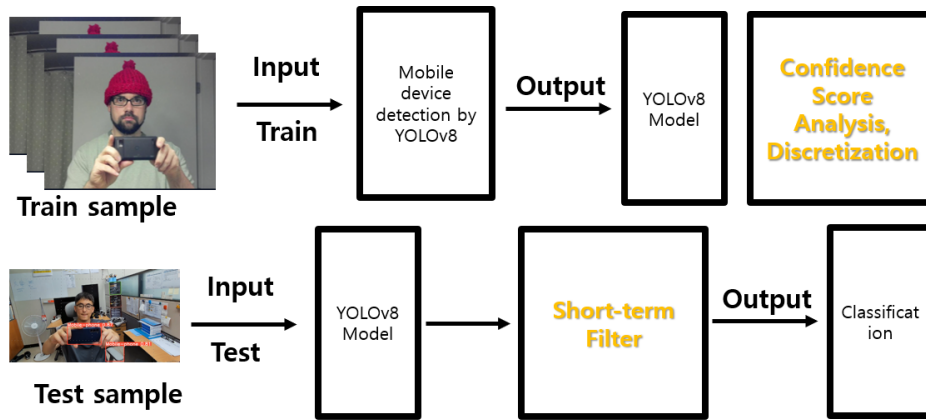


Figure 1. Suggested system diagram

Firstly, let me explain the discretization process. Discretization, also known as interval semantics, refers to dividing continuous variables into various categories. We primarily utilized the preprocessing library of scikit-learn for this purpose. Secondly, when drawing a confirmed Box using the trained YOLOv8 model, we filtered out all things that did not last for more than 1 second. We used the Relative Approximate Error method to quantify the size of the error value. As a result, while 5,439 (97%) were detected due to False Positive where 2,760 pieces of data should have come out in the normal process, after conducting discretization and short-term filter, 2,701 (2%) were found in the experiment.

$$\delta = 100\% \times \eta = 100\% \times \left| \frac{v - v_{\text{approx}}}{v} \right|$$

Figure 2. Relative Approximate Error

Acknowledgment

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Analysis of The Number of Views According to The YouTube Title using Regression Algorithm

Hyeonji Kim¹⁾ and Yoosoo Oh^{2,}*

¹⁾Dept.of Information and Communication Engineering, Daegu University, Korea.

²⁾School of AI, Daegu University, Korea.

E-mail: yoosoo.oh@daegu.ac.kr

Abstract: YouTube is a video-sharing platform that launched in 2005. For YouTube videos, the number of views varies depending on the title. In this paper, we analyze the number of views according to the title of Korean YouTube videos using a machine learning regression algorithm. In this paper, we learn the YouTube title as a feature value and the number of views as a target value. In this paper, we analyze using six machine learning regression algorithms (LinearRegression, KNN_Regression, SVR, KernelRidge, DecisionTree Regressor, and Gradient Boosting Regressor).

Keywords: YouTube, Machine learning, Regression, KernelRidge

Introduction

YouTube has a structure in which video creators' profits increase as the number of views increases. [2] Among YouTube metadata, the composition and length of the title determine the number of views on YouTube. [1] In this paper, we analyze the correlation between YouTube titles and views using six regression machine learning algorithms(LinearRegression, KNN_Regression, SVR, KernelRidge, DecisionTree Regressor, and Gradient Boosting Regressor). YouTube's title data is nonlinear string data. This paper used the CountVectorizer algorithm to predict the number of views according to the title. Countvectorizer is a method that extracts features from frequently appearing words in each document and vectorizes them. [3] In this paper, we learn using a nonlinear regression algorithm.

Analysis of the Number of Views according to the YouTube Title using a Regression Algorithm

In this paper, we use a machine learning regression algorithm to predict the number of views based on YouTube titles. Figure 1 is a diagram of the proposed system.

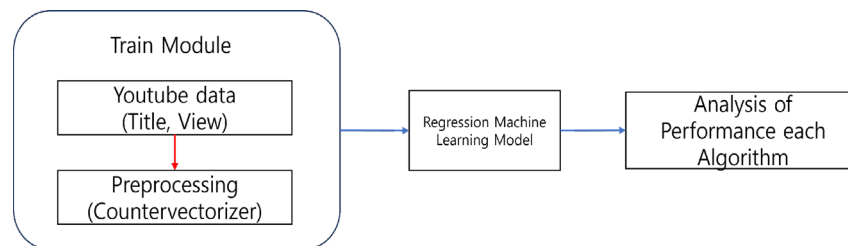


Figure 1. Diagram of the View Prediction System according to YouTube Title

This paper learns using 1000 YouTube titles and view count data. The proposed system embeds YouTube title data collected using a counterVectorizer algorithm. The CountVectorizer algorithm is a frequency-based embedding technique that is intuitive and simple.[3] This paper learns embedding data through six regression algorithms (LinearRegression, KNN_Regression, SVR, KernelRidge, DecisionTree Regressor, and Gradient Boosting Regressor). Performance is evaluated through regression algorithm evaluation indicators (MSE, RMSE, and R2 Score).

Conclusion

This paper confirmed the algorithm that yields the highest r2Score by analyzing six machine learning regression algorithms. As a result, the KernelRidge algorithm achieved the highest performance with an r2 Score of 0.91.

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Music Genre Classification of Philippine Music

Alden Robell M. de Loyola^{1,} and Robert R. Roxas²*

^{1,2}Dept. of Computer Science, University of the Philippines Cebu, Philippines.

E-mail: amdeloyola@alum.up.edu.ph

Abstract: This paper presents a study on Philippine music genre classification. The dataset was manually created by sampling audio features from 1,400 Philippine music tracks on seven genres, namely: *Rondalla*, *Kundiman*, *Kulintang*, *Manila Sound*, *Pop ballad*, *Rock*, and *Rap*. A total of 57 audio features were extracted using Librosa (python library for audio analysis) for each track, creating a dataset with size (1400, 57). Hyperparameter tuning was performed on the models using grid search with cross validation to find the best hyperparameters. The performance of the models was based how well each model performed on unseen data. After classifying the data, the models were evaluated using accuracy (model analysis) and recall (genre analysis). The results show that *k*-nearest neighbors, support vector machine, and random forest were the best-performing models, while decision tree was the worst-performing model as shown in Table I. Findings in this study aligned well with [1] and [2], where KNN, SVM, and random forest were the highest scorers. SVM scored 90% in handling this multiclass dataset, but it differed from the findings in [3], where SVM poorly performed with multiclass.

Rondalla: was easiest for the models to predict because the songs follow consistent musical patterns. The same was true for Kulintang (0.90 recall) as it sounded distinctly due to its instruments that no other genres utilized (gong ensembles). Kundiman, with 0.89 recall, is more complex with its varied vocals but was classified by the models well. Rap leveled with Kundiman due to its consistency in beats, percussive elements, and vocal cadences. Manila Sound was the genre, where most Rock mispredictions were found. This finding aligned exactly with [1], where most of the misclassification of Rock was concentrated on the disco genre. Manila Sound, the least predictable genre, was a fusion of musical styles from Filipino folk, Western music, and Latin rhythms – making it diverse and hard to predict for the models. Rondalla was the most predictable genre, followed by Kulintang, Kundiman, and Rap. Pop ballad, Rock, and Manila Sound were the difficult genres to predict. This study implies that popular machine learning models work well with the classification of Philippine music.

Keywords: music genre classification, machine learning, Philippine music, audio features

Table 1. COMPARISON WITH RELATED STUDIES

Dataset	KNN	SVM	Random forest	Logistic regression	Decision tree
This study	91.6%	90.62%	89.98%	82.67%	71.06%
Spotify [7]	68.40%	72%	-	-	-
GTZAN [1, 2]	92.69%	74.72%	80.28%	67.52%	-
GTZAN [6]	-	68.9%	-	-	74.3%
MSD [3]	-	52%	62%	-	61%
GTZAN [4]	67.5%	82.55%	-	67.5%	77.5%

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Biography

Alden Robell A. de Loyola was born in the Ormoc City, Philippines in 2001. He received the BS in Computer Science degree from the University of the Philippines Cebu, in 2023.

Robert R. Roxas was born in the Cebu City, Philippines in 1968. He received the BS in Computer Science degree from the Southwestern University, in 1993, and the MS in

Computer Science and Ph.D. in Computer Science & Engineering degrees from the University of the Philippines Los Baños and The University of Aizu in 1999 and 2004, respectively.

SESSION 3

Inclusive Education and Assistive Technology

Chair: Kyeong Ock Park (Daegu Univ.)

A National Snapshot of Assistive Technology for Students with Special Needs in South Korea

Jiyeon Kim¹⁾

¹⁾Dept. of Adapted Physical Education, Korea National Sport University, Korea.

E-mail: jykim@knsu.ac.kr

Abstract: Assistive technology (AT) which has been incorporated into the Act on Special Education for Disabled Persons, Etc. since 2008, supports students with special needs. The Ministry of Education and the State Office of Education has provided financial support to encourage the accessibility and utilization of AT among these students. However, the practical implementation for students with special needs does not consistently align with these efforts, and there is a notable lack of comprehensive research on the subject. Recognizing the significance and urgency of documenting the national AT landscape (Okolo & Diedrich, 2014), this study aims to capture the usage of AT across the country. The analysis is based on data from the 2020 Special Education Survey (V), mandated by the act to be conducted every three years.

The study purposed to describe the most prominent use of, or perceived unmet needs for AT and to compare the characteristics of users, non-users, and those expressing perceived unmet needs with respect to disability type, school level, educational placement, and socio-demographic features. Respondents for the data included a nationally representative random sample of 9,056 parents/guardians of students with special needs aged over 3 years, selected from a total population of 89,975 students with special needs. AT needs included disability-specific AT such as glasses, cane, screen reader, braille printer, braille information terminals, speech-to-text output, voice memory, magnifier, etc., in case of visual impairments. Unmet needs were defined as not receiving all needed AT. Descriptive statistics and logistic regression analysis were used to analyze data.

Data analysis involves the use of descriptive statistics and logistic regression analysis. The study provides parent-reported rates of AT use and perceived unmet needs based on various variables. Approximately twenty-four percent of students with special needs use AT, while thirty-seven percent do not require AT, and sixty-three percent have unmet needs. A noteworthy finding is that the likelihood of unmet AT needs is higher for students placed in general education classrooms compared to those in special schools and/or special classrooms. The implications and suggestions from the study findings for AT policy and future studies were discussed.

Keywords : assistive technology, National Special Education Survey, students with special needs, S. Korea, unmet needs

Acknowledgment

This research is non-commercial, and was conducted in the interest of AT for students with special needs. The author has not declared any specific grant for this research.

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Biography

Jiyeon Kim was born in Korea in 1976. She received the B.A. and M.Ed. degrees in special education from Dankook University in 1999 and 2004, respectively. In 2015, she earned her Ph.D. degree in

International Symposium on Innovation in Information Technology and Application (ISIITA 2024)
education with emphasis on special education, disability, & risk studies from the University of
California, Santa Barbara.

The Usefulness of Korean Painting in Art Therapy : Focusing on the Therapeutic Factors

Byeongmun Son¹⁾, Eunyeong Choi^{2,}, and Enok Bae³⁾*

¹⁾The Research Institute for Special Education & Rehabilitation Science, Daegu University, Korea.

²⁾Dept. of Rehabilitation Psychology, Daegu University, Korea.

³⁾The Research Institute for Special Education & Rehabilitation Science, Daegu University, Korea.

E-mail: 10engowen@naver.com

Abstract: This study attempted to confirm the usefulness of Korean painting in art therapy through literature analysis from the perspective of therapeutic factors. Therapeutic factors are mechanisms that evoke therapeutic changes that occur in the process of counseling(Yalom & Leszcz, 2005). In order to convincingly assert the usefulness of art therapy, it is necessary to explore specific therapeutic factors that evoke its effectiveness(Lee, 2016). Korean painting is a very Korean sort of expression based on Korean sentiment and aesthetics with Korean materials(Noh, 1995). In Western painting, artists prioritize changes in light and shade or spatial-temporal situations caused by sunlight, while Korean painting different from this approach by emphasizing the essence and inner nature of the material around spirituality and symbolism(Jeong, 2004). However, art therapy approaches using Korean painting are not actively carried out in Korean art therapy fields, and this phenomenon is the same trend in related research.

In order to conduct the study, Literature data related to the therapeutic factors were collected through the books of Korean painting and academic research on Korean painting art therapy. Academic research were searched by entering key words such as 'Korean painting & art therapy', 'Asian painting & art therapy', 'Ink painting & art therapy', 'Asian color-Ink painting & art therapy' and 'Asian color painting & art therapy', respectively. A total of eight academic papers were selected according to the inclusion and exclusion criteria of this study. In the case of the book, 'Korean painting', 'Asian painting', 'Ink painting', 'Asian color-ink painting', 'Asian color painting' were searched as key words by institute of providing academic data. Likewise, a total of 12 books were selected according to the inclusion and exclusion criteria. A total of 20 works, including academic papers and books, were selected as the final literature data. First of all, 391 basic statements related to art therapy factors inherent in the characteristics of Korean painting were collected from literature data. 151 statements were organized based on the four stages of integration and editing of qualitative data presented by Giorgi(1985). Three participants were asked to evaluate statements suitability for therapeutic factors of Korean painting art therapy. One is who majored in art therapy in graduate school while working as a Korean painter, one who is a professor of art therapy at the university and has more than four years of experience in Korean painting, last one who has been working as an art therapist for more than 10 years and has experience of studying therapeutic factors of art therapy. The participants derived 94 final statements and evaluated the importance of each statement on a 5-point scale. Each of these statements was made of cards and each card was categorized according to similarity by researcher.

The results of the study are as follows. The statements were categorized into 7. The first category consisted of 18 statements, and it was named Visual representation based on understanding of the Invisible dimension(importance: $M= 3.96$, $SD= .376$). The second category consisted of 13 statements, and was named 'communication with the outside world due to internal reflection(importance: $M= 4.18$, $SD= .675$). The third category consisted of 7 statements, and was named 'self-completion through discipline(importance: $M= 4.05$, $SD= .406$). The forth category consisted of 5 statements, and was named 'Expressions in a free state facilitated by the use of Korean art material(importance: $M= 4.13$, $SD= .181$). The fifth category consisted of 16 statements, and was named 'experience of mental and physical stability (importance: $M= 4.19$, $SD= .730$). The sixth category consisted of 14 statements, and was named 'learning harmony with the outside through experiencing nature(importance: $M= 3.93$,

$SD = .417$). The seventh category consisted of 21 statements, and was named 'Acquiring psychological resources through abundant aesthetic experience(importance: $M = 4.21$, $SD = .307$)'. This study attempted to classify and categorize therapeutic factors of Korean painting art therapy based on a literature review, and it also evaluated their significance in terms of importance. Based on the result, it is intended to lay the groundwork for the practical application of Korean painting art therapy in the art therapy field and related research.

Keywords : Korean Painting, Art Therapy, Therapeutic Factors

Acknowledgment

This research was partially supported by the Ministry of Education and National Research Foundation of Korea(NRF-2022S1A5C2A07091326). We thank our colleagues from the Ministry of Education and National Research Foundation of Korea who provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations/conclusions of this paper.

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Biography

Eunyeong Choi was born in Daegu, Republic of Korea in 1970. She received the B.A. degree in psychotherapy from Daegu University, in 1992, and the M.S. degree in rehabilitation science from Daegu University, in 1994, and Ph.D. degrees in special education from Daegu University in 1999.

Byeongmun Son was born in Seoul, Republic of Korea in 1989. He received the B.A. degree in English language and literature from Korea University, in 2016, and the M.S. degree in rehabilitation psychology from the college of the rehabilitation sciences in Daegu University, in 2018, and Ph.D. degree in rehabilitation science from Daegu University in 2023.

Enok Bae was born in Gwangju, Republic of Korea in 2000. He is working as a research assistant at the research institute for special education & rehabilitation science at Daegu University. He is a second year student in the department of special education at Daegu University.

Special Education Teachers' Experiences and Perceptions Regarding the Use of Artificial Intelligence for Teaching Students with Disabilities

Min Wook, Ok¹⁾, Kyoung Ock, Park²⁾, and Jiyeon Kim^{3,)}*

¹⁾Dept. of Special Education, Daegu University, Korea.

²⁾Dept. of Elementary Special Education, Daegu University, Korea.

³⁾Dept. of Adapted Physical Education, Korea National Sport University, Korea.

E-mail: jykim@knsu.ac.kr

Abstract: Due to the rapid advancements in artificial intelligence (AI) technology, its adoption and dissemination have accelerated, characterizing the current era as the age of AI (Bah & Artaria, 2020). The growing prominence of AI underscores the increasing significance of AI education within the field of education. The integration of AI is bringing about substantial transformations in the lives and education of students with disabilities. However, challenges such as limited cognitive abilities and restrictions in accessibility pose obstacles to the effective utilization of the internet and digital devices, impeding AI education for students with disabilities. Consequently, a noticeable digital divide has emerged between students without disabilities and those with disabilities in educational settings (Ok, Park, & Kim, 2023).

The purpose of this study was to investigate the experiences and perceptions of special education teachers regarding the use of AI for educating students with disabilities, as well as to identify strategies and support needs for successful use of AI in the special education fields. To achieve this, an online survey was conducted with 330 special education teachers in K-12 schools nationwide in the Republic of Korea, and the collected data were analyzed using descriptive statistics.

The key findings of this study are summarized as follows: First, special education teachers had a relatively low level of knowledge regarding the use of AI in the education of students with disabilities. However, they demonstrated a high level of interest and a strong intention to incorporate AI in the future. Similarly, while they recognized the necessity of AI education for students with disabilities, they felt inadequately prepared for AI education.

Second, the utilization of AI for teaching students with disabilities among special education teachers was found to be low. Those who had used AI reported they predominantly employed it for 'supporting teaching and learning activities' and 'recommending/selecting teaching materials and media.' Also, it was reported that they used AI devices such as AI speakers, AI robots, generative AI, and AI-based educational programs, as well as speech recognition programs for teaching students with disabilities.

Third, special education teachers identified subjects such as mathematics, language arts, career and vocational education, and creative experiential activities as suitable for incorporating AI. They emphasized the significance of AI in implementing teaching and learning plans for students with disabilities, particularly for 'supporting teaching and learning activities,' 'recommending/selecting teaching materials and media,' and 'providing information for teachers to improve teaching and students to improve learning.'

Fourth, a majority of special education teachers believed that the introduction of AI would positively impact on special education in the future. They highlighted advantages such as 'access to various teaching materials,' 'stimulation of interest and participation in learning for students with disabilities,' 'accumulation and analysis of student academic achievement data,' and 'realization of individualized education.' However, they also acknowledged limitations and challenges, including 'the lack of AI content and teaching materials suitable for the educational needs of students with disabilities,' 'burden on teachers for acquiring and using new technology,' 'lack of expert consulting and training opportunities to support AI education' and privacy violations, information leakage, and problems with information management and protection.'

Fifth, a significant number of special education teachers had participated in AI education training experiences of less than 5 hours and their interest in participating in such training was very high. They

expressed that effective AI education training should encompass contents such as 'practical training on the use of AI content for teaching students with disabilities', 'methods of integrating AI into the curriculum,' and 'sharing experiences and success stories on the educational use of AI.'

Lastly, special education teachers identified support needs for successful AI education for students with disabilities, including 'the development of AI content and tools suitable for the educational needs of students with disabilities,' 'development of textbooks and manuals on the use of AI for teaching students with disabilities', 'provision of teacher training to enhance their ability to use AI' and 'establishment of a physical environment for the use of AI.' Based on the results, the implications for the field and future research directions will be discussed.

Acknowledgment

This research was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea(NRF-2022S1A5C2A07091326).

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Biography

(First Author) Min Wook, Ok was born in Seoul in 1982. She received the B.E. degree in special education from Dankook University in 2006, and M.Ed. and Ph.D. degrees in special education from The University of Texas at Austin in 2008 and 2014, respectively.

(Co-Author) Kyoung Ock, Park was born in Seoul in 1967. She received the B.E. degree in special education from Dankook University in 1991 and the Ph.D. degree in special education from Dankook University in 2006.

(Corresponding Author) Jiyeon Kim was born in Korea in 1976. She received the B.A. and M.Ed. degrees in special education from Dankook University in 1999 and 2004, respectively, and a Ph.D. degree in education with an emphasis on special education, disability, and risk studies from the University of California, Santa Barbara, in 2015.

The Development of Metaverse-based Educational Content for Improving Social Skills of Students with Developmental Disabilities.

Kyungin Han¹⁾, Daesong Lee^{2)}, Seohyeon Noh³⁾, Yunhee Shin⁴⁾, and Kyuman Jeong⁵⁾*

¹⁾Institute of Special Education & Rehabilitation Science, Daegu University, Korea.

²⁾Gyeongsangnamdo Hamyang office of Education, Korea.

³⁾Bansong Elementary School, Korea.

⁴⁾Behavior Therapy, Daegu Cyber University, Korea.

⁵⁾School of AI, Daegu University, Korea.

E-mail: spedulove@naver.com

Abstract: This study developed metaverse-based educational content for positive behavior support (PBS) to prevent challenging behaviors in students with developmental disabilities, utilizing the advantages of metaverse-based education in overcoming spatial and temporal constraints and enhancing learner engagement and immersion. The educational content was designed to improve social skills in connection with the social studies curriculum of the 2015 special education curriculum. The development process involved the following steps: First, we conducted a literature review and needs assessment of special education teachers regarding the application of metaverse in education. Second, we analyzed the special education social studies curriculum and extracted relevant educational content related to social skill enhancement. Some of this content has been presented in Table 1.

Table 1. The examples of Social Studies Achievement Standards and Extracted Social Skills according to 2015 Basic Curriculum of Special Education

Achievement Standards	Social Skills
[6 social studies 01-02] Know and practice what to do on your own in everyday living spaces such as home and school.	Organizing, tidying up, and cleaning my home
	The tasks I need to do at home
	Organizing, tidying up, and cleaning in my classroom
	The tasks I need to do in my classroom

Third, Based on this content, we have set up four social situations (tidying up at home after returning from school, having lunch at school, organizing the house, purchasing items from a store for errands at home) and created a preliminary storyboard to teach social skills in each situation. Some of the content from the preliminary storyboard for the situation of tidying up at home after returning from school is presented in Table 2.

Table 2. Some of the content from the preliminary storyboard for the situation of tidying up at home after returning from school

Situation	Place	Behavior
tidying up at home after returning from school	home (entrance-living room-my room)	Say hello
		Organizing one's shoes
		Put your bag in place
		Hanging clothes on hangers
		Taking off your socks and organizing them
		Washing your hands
		Organizing my room
		Check notification letter / Getting ready for school

Fourth, based on the storyboards, we collaborated with a metaverse development company to develop the metaverse educational content. We have created storyboards for each scene to enable implementation in a metaverse environment, including titles, backgrounds, screen descriptions, interactions, and specific plans for BGM/Effect/subtitles. Figure 1 shows a specific storyboard plan for

one of the scenes in the overall social situation and how it has been implemented in the metaverse environment.

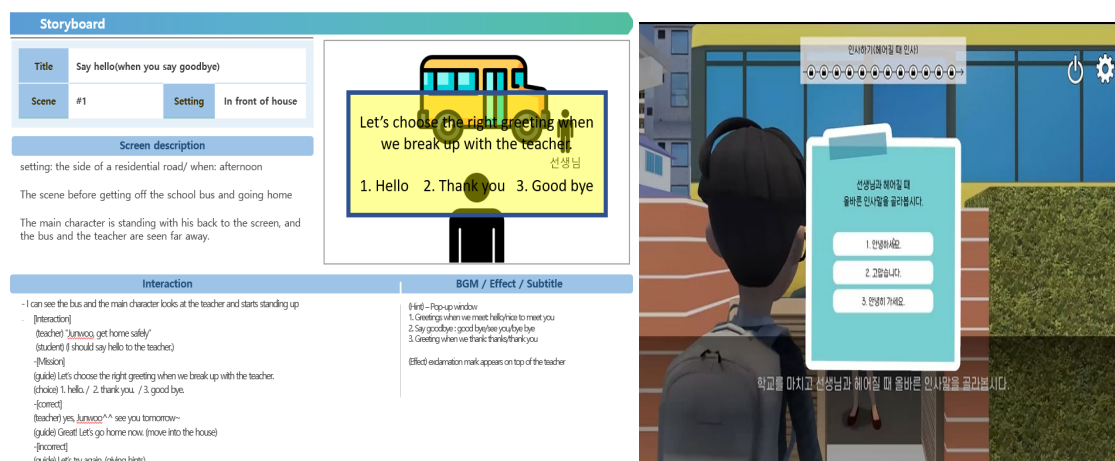


Figure 1. A specific storyboard plan, and an implemented scene in the metaverse environment.

We conducted a validity and usability evaluation forum with experts to assess the developed content and the execution of the metaverse. The final metaverse educational content was completed based on the feedback received. The social skills-enhancing metaverse educational content developed in connection with the special education curriculum is expected to greatly benefit students with developmental disabilities in improving their social skills, and it is anticipated to be widely utilized during school curriculum hours. It is suggested to develop instructional materials and manuals for systematic utilization of the social skills-enhancing metaverse educational content in both school and home settings.

Keywords : Metaverse, Educational content, Social skills, Students with developmental disabilities

Acknowledgment

This research was supported by the Ministry of Education and the Korea Research Foundation in 2022 in Republic of Korea. (NRF-2022S1A5C2A07091326)

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The Effect of Positive Behavior Support Through Non-face-to-face Coaching on Self-harming Behavior and Classroom Participation Behavior in High School Students with Developmental Disabilities

Juyeonr Yun¹⁾, Kyoungock Park²⁾, Pureum Ji¹⁾, and Gyouhee Kim³⁾

^{1,3)}The Research Institute for Special Education & Rehabilitation Science, Daegu University, Korea.

²⁾Dept. of Elementary Special Education, Daegu University, Korea.

E-mail: tala0417@hanmail.net

Abstract: This study aims to verify the effects of positive behavior support through non-face-to-face coaching on self-harming behavior and classroom participation of high school students with developmental disabilities. Positive behavior support through non-face-to-face coaching was implemented for one high school student with developmental disabilities in a special education school. A total of 42 sessions were conducted, consisting of 2 sessions of face-to-face coaching and 7 sessions of non-face-to-face coaching. To observe self-harming behavior and classroom participation, a total of 50 minutes, including morning class time and break time, were observed. Considering the behavioral characteristics, the observation was divided into 16 intervals at 3-minute intervals to measure the occurrence rate of behaviors. Behavioral interventions were conducted through indirect and direct assessments to evaluate the function of behaviors. Various multi-component intervention strategies were formulated considering different situations and environments, and the changes in behavior were analyzed after application. Positive behavior support through non-face-to-face coaching resulted in a reduction in self-harming behavior and an increase in classroom participation among high school students with developmental disabilities. Furthermore, the reduction in self-harming behavior and the increase in classroom participation were sustained even after the intervention ended. Within the context of a special education school, self-harming behavior of high school students with developmental disabilities decreased, and their participation in class increased. Additionally, behavioral changes were maintained even after the withdrawal of the intervention. These findings suggest that positive behavior support through both face-to-face and non-face-to-face coaching can be effective in bringing about behavioral changes in high school students with developmental disabilities. Visual graphs depicting the behavioral changes of high school students with developmental disabilities are presented in Figure 1.

Keywords: Non-face-to-face coaching, positive behavior support, developmental disabilities, self-harming behavior, classroom participation behavior

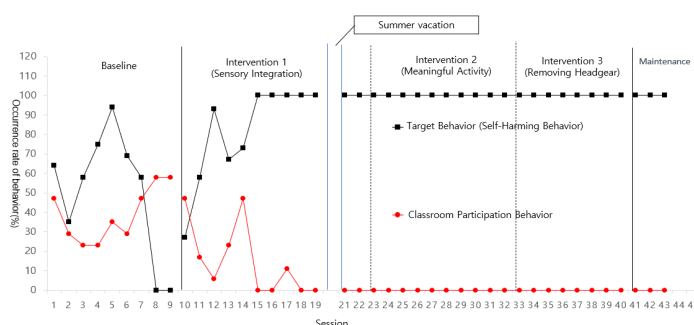


Figure 1. A sample line graph

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Acknowledgment

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Biography

Juyeon Yun was born in Gwangju, South Korea, in 1972. She obtained a master's degree in special education from Dankook University in 2008, and later, in 2011, earned a Ph.D. in special education from Daegu University.

Gyeong-ok Park was born in Gyeonggi-do, South Korea, in 1967. She holds a degree in special education and earned both a master's and a doctoral degree in special education from Dankook University. Currently, she serves as a professor in the Department of Elementary Special Education at the College of Education, Daegu University.

Pureum Ji was born in Daegu, South Korea. She is a doctoral candidate in the Special Education program at the Graduate School of Daegu University. Currently, she works as a special education teacher at Seongbo School in Daegu City

Gyuhee Kim was born in Ulsan, South Korea. She is a master's degree candidate in the Special Education program at the Graduate School of Daegu University. Currently, she works as a researcher at the Research Institute for Special Education & Rehabilitation Science, Daegu University.

SESSION 4
Interactive Posters
Chair: Jeong Tak Ryu (Daegu Univ.)

Radar Signal Processing Scheme for Human Identification

YoungSeok Jin¹⁾, Ji-Eun Bae²⁾, Inoh Choi³⁾, and Eugin Hyun^{4,}*

^{1,2,4)}IS Lab, Dept. of Automotive Technology, DGIST, Korea.

³⁾Div. of Electronics and Electrical Information Engineering, KMOU, Korea.

E-mail: {ysjin, jebae@dgist.ac.kr / inohchoi@kmou.ac.kr / braham@dgist.ac.kr

Abstract: Radar sensor is major technology of defense to detect the range and velocity of object using microwave echo signal. Today, in commercial area, the radar sensor has focused on applying the various applications. However, the current killer application of radar sensors was limited to the applications of smart cars [1]. Recently, with the smart platforms such as smart buildings, smart homes, and smart cities, radars are beginning to be applied to various fields such as home appliances, lighting, and security [2]. The optical based sensors such as camera and lidar are very sensitive depending on the external environments of weather and lighting condition. Moreover, because these sensor can exist about privacy concerns, there is a sense of reluctance among consumers [3]. In other hands, the radar sensor is very robust against the external conditions, and it can directly detect range between radar and object and the radial velocity of moving target. The radar sensor also detect the vital sign of human [3]. But, because the radar sensor has very low angle resolution compared with camera sensor, there is limitation to classify the type of objects [3]. Moreover, unlike camera sensor, since the radar sensors require customized hardware for each application, while camera sensor, making difficult for radar sensors to apply the various area. In spite of these limitations, the radar sensor is very attractive solution to detect human. If radar sensor can easily classify the human among other objects, the solution can be applied into the various smart applications. In addition, if radar sensor can identify the individual person using the detected vital sign and motion signature, the radar sensor can become the major sensor for surveillance and security applications.

One of the popular radar methods in the commercial area is FMCW (Frequency Modulated Continuous Wave) method. The FMCW can detect both the ranges and velocities of multiple objects. However, the transceiver circuit is complicated and power is more consumed due to the PLL (Phase Lock Loop) component, compared to the CW (Continuous Wave) radar [4]. On the other hand, CW radar can be designed with a simple architecture, but it is limitation to detect only velocity of single object. However, the presence of moving human and the vital-sign of stationary human can be easily measured with simple signal processing method [4]. Because the breathing signal has very low frequency, which is close to the DC (Direct Current), it is difficult to design a sharp filter to remove only the DC signal and pass the vital signal. Therefore, in order to detect vital signal in CW radar, we should install the LPF (Low Pass Filter) to remove only high frequency signals such as motion of human. On the other hand, to detect a moving object with weak echo at long range, the amplifier should be connected into baseband. At this time, DC and low-frequency signals must first be removed to prevent signal saturation. Therefore, it is impossible to simultaneously detect the motion of a moving human and the breathing signal of a stationary human using the conventional transceiver circuit of CW radar with a single baseband.

In this paper, we propose human identification scheme using detected breathing signal of standing human and gait-rate of moving human with the designed a CW radar front-end.

Keywords : radar, CW radar, radar signal processing, human detection.

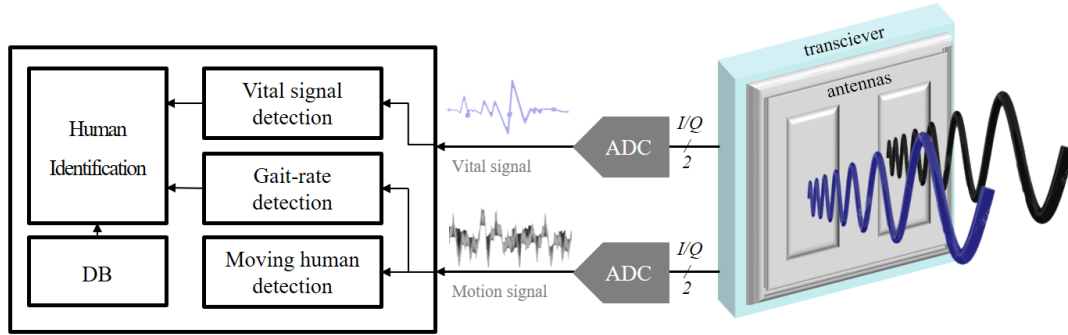


Figure 1. The designed radar platform concept

Acknowledgment

This work was supported by the National Research Foundation of Korea(NRF) grant funded by the Korea government(MSIT)(NO.RS-2023-00219725, Regional Leading Research Center on Development of Multimodal Untact Sensing for Life-Logging) and the DGIST R&D Program of the Ministry of Science and ICT (No. 23-SENS2-7, Development of Machine Learning Based Human Identification Scheme using Dual-Baseband Doppler Radar Sensor)

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Biography

Eugin Hyun was born in Daegu, Korea in 1974. He received the B.E. degree in electronic engineering from the Yeungnam University in 1999, and the M.E. and Ph.D. degrees in electronic engineering from the Yeungnam University in 2001 and 2005, respectively. Since 2005, He has been working as a principal researcher at IS³ Lab, Daegu Gyeongbuk Institute of Science & Technology DGIST.

YoungSeok Jin was born in Daegu, Korea in 1983. He received the B.S. and M.S. degrees in Communication Engineering from Daegu University, in 2010 and 2012. Since 2012, he is currently working in IS³ Lab, Daegu Gyeongbuk Institute of Science & Technology (DGIST), Korea, as researcher.

Ji-Eun Bae was born in Geoje-si, Korea in 1996. She received the B.E. degree in electronic engineering from the Keimyung University, in 2020. Since 2020, she is currently working in IS³ Lab, Daegu Gyeongbuk Institute of Science & Technology (DGIST), Korea, as researcher.

Inoh Choi received the B.S. and M.S. degrees in electronic engineering from Pukyong National University in 2012 and 2014, respectively. He received the Ph.D. degree in electronic engineering from Pohang University of Science and Technology in 2020. Since 2021, he is currently working in the Division of Electronics and Electrical Information Engineering, National Korea Maritime & Ocean University, as an assistant professor.

Mastectomy skin flap stability prediction using indocyanine green angiography : A randomized prospective trial

Min Ji Kim¹⁾, Hyoseob Lim²⁾, and Il Jae Lee^{3,*)}

^{1,2,3)}Department of Plastic and Reconstructive Surgery, Ajou University School of Medicine, Korea.

E-mail: i00325@live.co.kr

Abstract: Background: The first step in successful breast reconstruction is obtaining a stable skin flap. Indocyanine green (ICG) angiography has recently been studied for its value and usefulness in predicting the stability of skin flaps; however, relevant prospective studies of its clinical efficacy are limited.

Objectives: To prospectively investigate the clinical impact on breast reconstruction outcomes of intraoperatively using ICG angiography.

Methods: Between March and December 2021, 64 patients who underwent immediate breast reconstruction at the authors' institution were prospectively enrolled. They were classified into an experimental group (n=39; undergoing ICG angiography) and a control group (n=25; undergoing gross inspection alone). In the absence of viable skin, debridement was performed at the surgeon's discretion. Skin complications were categorized as skin necrosis (the transition of the skin flap to full-thickness necrosis) or skin erosion (a skin flap that did not deteriorate or become necrotic but lacked intactness).

Results: The 2 groups were matched in terms of basic demographic characteristics and incision line necrosis ratio ($p=0.354$). However, intraoperative debridement was significantly more frequent in the experimental group (51.3% vs 48.0%, $p=0.006$). The authors additionally classified skin flap necrosis into partial- and full-thickness necrosis, with a higher predominance of partial-thickness necrosis in the experimental vs control group (82.8% vs. 55.6%; $p=0.043$).

Conclusions: Intraoperative ICG angiography does not directly minimize skin erosion or necrosis. However, compared to gross examination alone, it enables surgeons to perform a more active debridement during surgery, thereby contributing to a lower incidence of advanced skin necrosis. In breast reconstruction, ICG angiography may be useful for assessing the viability of the post-mastectomy skin flap and could contribute to successful reconstruction.

Keywords : Indocyanine green angiography, near infrared camera, breast cancer, mastectomy

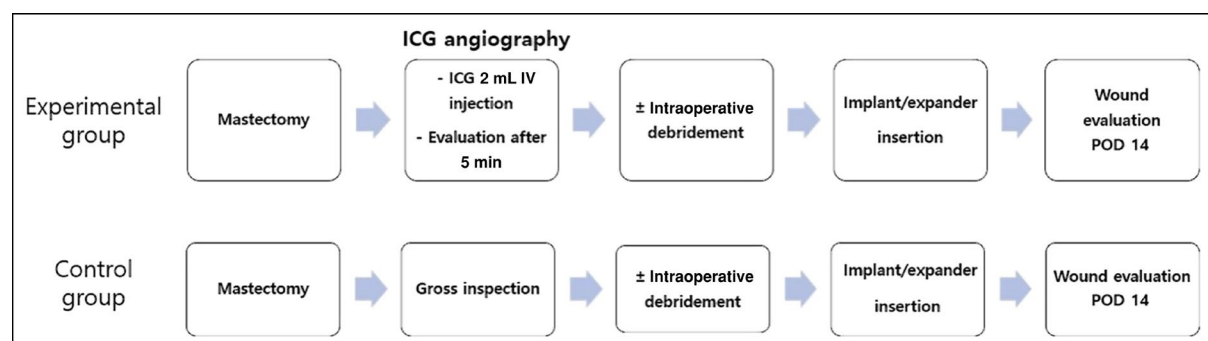


Figure 1. The prospective randomized controlled study design for treatment of breast cancer patients and subsequent reconstruction.

Patients were randomly classified into 2 groups: experimental and control. Only the experimental group underwent intraoperative ICG angiography, and based on the results, the surgeon performed skin

flap debridement. In the operation field, ICG was diluted in distilled water and 2 mL of this solution was injected. After 5 minutes, we evaluated breast skin perfusion status via an infrared camera. In the control group, intraoperative debridement was based on the surgeon's gross inspection evaluation of the skin flap. ICG, indocyanine green; POD, postoperative day

Variable	Estimate	Standard error	Wald	P-value	Exp(B)	95% CI of exp(B)	
						Lower	Upper
Experimental group	-1.002	0.795	1.590	.207	0.367	0.077	1.743
Mastectomy volume (mL)	-0.001	0.004	0.099	.753	00.999	0.991	1.006
Implant volume (cc)	0.004	0.006	0.428	.513	1.004	0.993	1.015
Width (cm)	-1.230	1.217	1022	.312	0.292	0.027	3.175
Height (cm)	-1.293	1.577	0.672	.412	0.274	0.012	6.038
Surface area (cm ²)	0.098	0.102	0.915	.339	1.103	0.903	1.347
Incision line (cm)	-0.055	0.167	0.109	.741	0.946	0.682	1.313
Intraoperative debridement	0.409	0.790	0.269	.604	1.506	0.320	7.082
Constant	14.411	18.627	0.598	.439	1813129.575	—	—

Nagelkerke $R^2 = 0.230$; Hosmer-Lemeshow test = 6.970(.540).

Figure 2. Logistic Regression Analysis of Variables Related to Postoperative Mastectomy Skin Flap Revision

Acknowledgement

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Biography

Il Jae Lee was born in Seoul in 1975. He received the B.E. degree in medicine from the University of Ajou, in 2000, and Ph.D. degrees in medicine from the Ajou University in 2011.

Selective Alignment of DNA Molecules using Local Surface Charges controlled by Plasma Ashing Method

Hyung Jin Kim^{1,*} and Doyoung Kim¹⁾

¹⁾School of Electrical & Electronic Engineering, Ulsan College, Korea

E-mail: hjkim745@gmail.com

Abstract: In this paper, a simple and efficient method for selective positioning of Au/DNA hybrid nanocircuits is reported by using a sequential combination of electron-beam lithography (EBL), plasma ashing and a molecular patterning process. The nanostructures produced by the EBL and ashing process could be uniformly formed over a large-area substrate with sub-10 nm patterning with high-aspect-ratio. In addition, DNA molecules were immobilized on the selectively nanopatterned regions by alternating surface coating procedures of 3-(aminopropyl)triethoxysilane (APS) and diamond like carbon (DLC) and then immobilized DNA molecules can be rearranged into a well-defined single DNA nanowire. These single DNA nanowires were used not only for fabricating Au/DNA hybrid nanowires by the conjugation of Au nanoparticles and DNA nanowires, but also for formation of Au/DNA hybrid nanocircuit. This nanocircuit prepared by Au/DNA hybrid nanowire shows up to 4.3×10^5 S/m in stable electrical performance. This selective and precise positioning method capable of size control of nanostructures may find application in making sub-10 nm DNA wires and metal/DNA hybrid nanocircuits.

Keywords : DNA, nanowire, 10nm, APS, and nanocircuits

[a] AFM topography image with the numbers 1 and 2 indicating each nanowire line array. [b] Electrical properties (current-voltage) of nanocircuits made from Au/DNA hybrid nanowires.

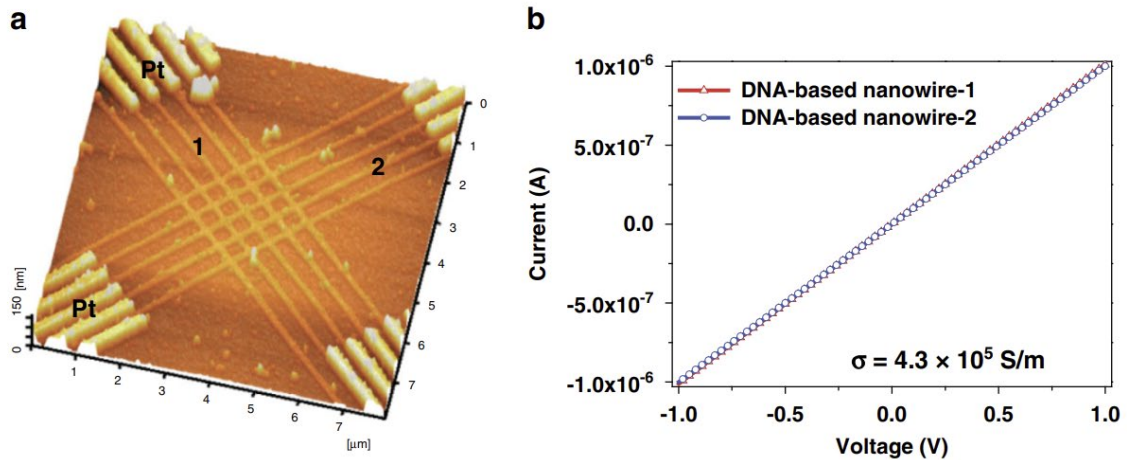


Figure 1. Nanocircuit fabrication using Au/DNA hybrid nanowire arrays fixed between two Pt electrodes.

Acknowledgment

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A method for improving latency between devices equipped with speakers

Cheoljae Kim¹⁾, Seokwon Hong²⁾, Hyeol Yang³⁾, and Kyuman Jeong^{4,)}*

¹⁾Dept. of Information and Communication Engineering, Daegu University, Korea

²⁾An Industry-Academic Cooperation Group, Daegu University, Korea.

^{3,4)}School of AI, Daegu University, Korea

E-mail: ndo04054@naver.com / sw071497@gmail.com / isac0830@naver.com / kyuman.jeong@gmail.com

Abstract: The Delays in various wireless communication technologies in using IOT devices cause inconvenience to many people using the device. This imposes restrictions on properly enjoying various multimedia provided by modern society, and technologies to reduce delays are also steadily increasing to correct them. However, most studies are for connectivity at lower levels. Reducing time delay in the new standard will help develop future technologies, but ways to reduce delays in various existing wireless communications are expected to provide users with a better experience. In this paper, we introduce a method of correcting the time delay in a software way. In addition, we describe how to correct existing time delays by providing data on whether they can be corrected equally for various devices and various wireless transmission protocols. In this paper, a protocol to reduce delay time with Wi-Fi communication using Raspberry Pi was completed and an experiment was conducted. This is expected to provide a better communication environment to users in the future.

Keywords : IoT, Latency Improvement, Raspberry Pi

Table 1. Experimental results

	Experimental results			
	Experimental method	Source bytes	Bytes of transferred files	Average percentage
1	Fixed delay time	4,034,555	4,023,754	99.73%
2	Variable delay time		4,027,994	99.84%

In this experiment, P2P communication was performed using two Raspberry Pi 4B boards. The two devices belong to different networks, and the experiment was conducted by transferring files through UDP communication and then calculating the loss rate. However, since expensive equipment is required to communicate and test sound quality, in this experiment, the MP3 file was binarized, converted into a text file, and transmitted, and the device that received the text file was forced to convert the text file back into an MP3 file. For comparison, the exchanged binary files were compared.

When communication begins, text files are read and transmitted line by line, and at this time, each line is read by Delay to implement a variable delay time. Delay first started transmitting to Imin and communicated by gradually increasing the delay value to the maximum Imax if the communication status is good, that is, the loss rate is low. If the loss rate increased during communication, the experiment was conducted by reducing the delay value again. As a result of calculating the loss rate by repeating this process several times, it was confirmed that in addition to the method of fixing the delay time and then correcting it, it can be corrected through a variable delay time.

Each experiment was conducted by fixing 10 different sound source files at 5 ms, and the other was made to communicate between Imin and Imax values. fig 1. below shows the communication of sound source files. TABLE 1. represents the average of 10 experiments. A total of 4034555 bytes of packets were sent, and Experiment 1 was transmitted at 5 ms fixedly, and Experiment 2 was transmitted at Imax value from Imin. The results show that Experiment 2, which is the method proposed in this study, is 0.09% more efficient than Experiment 1.

Results: In a P2P communication experiment using Raspberry Pi 4B boards on different networks, files were transferred through UDP, and loss rates were calculated. To simulate sound quality testing, MP3 files were binarized and transmitted as text files. The receiving device converted them back. Variable delay times were implemented, starting from Imin and gradually increasing to Imax with good communication status. If loss rates increased, delays were reduced. Results, based on 10 sound source files at fixed 5 ms (Exp 1) and variable delay from Imin to Imax (Exp 2), showed Exp 2 to be 0.09% more efficient than Exp 1, totaling 40345555 bytes sent.

Acknowledgment

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2022S1A5C2A07091326).

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Biography

Cheolja Kim was born in Korea in 1998. He is currently a master course student in the field of AI in Daegu University.

Kyuman Jeong received his B.S. degree in Computer Science from Korea Advanced Institute of Science and Technology (KAIST) in 1998 and his M.S. and Ph.D. degrees in Computer Science and Engineering from Pohang University of Science and Technology (POSTECH) in 2000 and 2007, respectively. From 2007 to 2009, he worked as a senior engineer at the Mobile Communication Division of Samsung Electronics in Suwon, Korea. Currently, he is a professor at Daegu University. His research interests include artificial intelligence, mobile graphics applications, and computational photography.

Learning deep models for face anti-spoofing by pixel-wise supervision with depth labels

Myoung-Kyu Sohn¹⁾, Sang-Heon Lee¹⁾, Hyunduk Kim¹⁾, Junkwang Kim¹⁾

¹⁾Division of Automotive Technology, DGIST, Daegu, Korea.

E-mail: smk@dgist.ac.kr / pobbylee@dgist.ac.kr / hyunduk00@dgist.ac.kr / kjk1208@dgist.ac.kr

Abstract: With the development of face recognition technology, vision-based face recognition systems are widely used. At the same time, various methods of attacking these face recognition systems have also begun to emerge. In this paper, we implement two types of anti-spoofing systems that detect such spoofing attacks in a face recognition system using a deep learning network. The performance of the two systems was compared. A simple binary classifier using the entire face image and a depth information-based classifier that estimates depth information on a pixel basis is implemented. The performance of the implemented network was evaluated using the CelebA-Spoof database and the results of the two networks were compared.

Keywords : face recognition, anti-spoofing, deep learning.

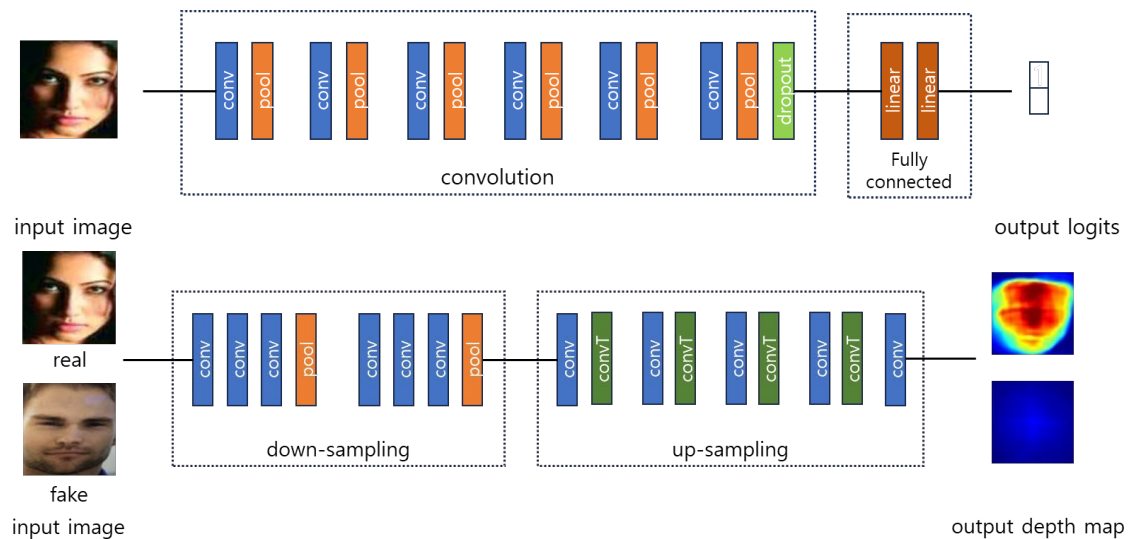


Figure 1. Overall architecture of deep learning network
a) Binary classification (upper) b) Pixel-wise depth estimation (lower)

Figure 1 shows the structure of the CNN architecture used in each method. The network used in binary classification stacked several convolutional layers and used a fully connected layer for the final output. The final output is a vector that can immediately distinguish between a fake face and a real face. The depth information-based classifier has a U-net [5] type network structure and uses downsampling by convolution followed by upsampling by transpose convolution. Instead of using a fully connected layer, the output from the upsampling stage is used directly, and the output is depth information.

Acknowledgment

This work was supported by the DGIST R&D Program of the Ministry of Science and ICT (23-IT-02). It was also supported by the Technology Development Program of MSS (S3237206)

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Biography

Myoung-Kyu Sohn received a B.S. degree in Electrical Engineering from Kyungpook National University, Daegu, Korea in 1997, an M.S. degree in Electrical Engineering and Computer Science from Seoul National University, Seoul, Korea in 1999, and a Ph.D. degree in Electrical Engineering from Kyungpook National University in 2017. He is now a senior researcher at Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea, joined in 2005. His research focus is deep learning and computer vision for human-computer interface. (Sang-Heon Lee) received a B.S. and M.S. degree in Electronics from Kyungpook National University, Daegu, Korea in 1993 and 1996. He also received a Ph.D. degree in Electrical Engineering and Computer Science from Kyungpook National University in 2013. He is interested in Deep Learning and Image Recognition and has been serving as a principal research scientist at Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea since 2005. (Hyunduk Kim) received a B.S. degree in Mathematics from Kyungpook National University, Daegu, Korea in 2009 and an M.S. degree in Applied Mathematics from Kyungpook National University, Daegu, Korea in 2012. He is now an associate researcher at Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea, joined in 2012. His research interests include artificial intelligence and face analysis.

Junkwang Kim received a B.S. degree in Computer Science from Keimyung University, Daegu, Korea in 2013 and an M.S. degree in Mobile Communication Engineering from Kyungpook National University, Daegu, Korea in 2018. He is now an associate researcher at Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea, joined in 2013. His research interests include artificial intelligence and detection.

The effects of various core exercise on biomechanical properties of lower limb muscles in healthy young individuals during 12-weeks

Hyuk-Jae Choi¹⁾, Won-Young Lee²⁾, InHo Hwang¹⁾, Chang-Yong Ko^{3,*)}, and Sung-Phil He^{4,*)}

¹⁾Dept. of Research & Development, Rehabilitation Engineering Research Institute, Korea Workers' Compensation & Welfare Service, Korea.

²⁾Dept. of Institute of Sports Medicine, Hannam University, Korea.

³⁾Dept. of Research & Development, Refind Inc, Korea.

⁴⁾Gangneung-Wonju National University, Korea.

E-mail: spheo@gwnu.ac.kr

Abstract: Core exercise (CE) has been applied as a popular exercise method in the sports medicine and rehabilitation programs. For effects of CE, these evaluating regions were limited to the axial skeleton except for the upper and lower extremities. The main principle of core motion is to facilitate the transmission of force and momentum from core region to the limbs according to a kinetic chain theory. Therefore, the effect of CE on the lower extremity is positive, and it is considered that research is necessary. We intend to study the effects of various CEs on the change of biomechanical properties the lower extremity muscle in the healthy individuals through myotonometer (MyotonPRO, Esotonia). Twenty three healthy persons(male/female=12/11, age M/F=21.4±1.0/21.0±1.6yr) enrolled in this study. Twelve subjects were allocated into CEG (Core_Exercise Group) and they continued to participate in the core exercise for 12 weeks at 3 times or more each week, 80 minutes per session. On the other hand, 11 subjects were allocated into NCEG (Non_Core_Exercise Group, n=11) and they did not apply the core exercise. The core exercise program was consisted of 5 major core exercises (squat, skater, plank, crunch & bridge, and leg raise). Oscillation frequency (F, Hz) of RF (rectus femoris), TA (tibialis anterior), BF (biceps femoris), GCM (gastrocnemius) for dominant lower extremities were measured by using MyotonPRO. F is the intrinsic tension of the muscle in the resting state with nonvoluntary contraction, as muscle tone. There was no significant difference between pre and post-test in the NCEG, but the F values of all muscles in CEG significantly increased in Table 1. It is believed that 5 CEs during 12 weeks can have a positive effect on the F value. This is useful to be in managing muscle in the lower extremity muscles within the normal range by applying CE of an appropriate duration and intensity, and in preventing damage to the lower extremity region when participating in various exercises.

Keywords : Muscle tone, Biomechanical properties, MyotonPRO, Core exercise, lower limb muscles

Table 1. Results of frequency through 2way RM ANOVA

	Group	Pre	Post	p_Time	So.	F	p
Rt_RF_F	CEG(n=12)	15.05±1.6 [†]	16.12±1.84	0.003	T	11.512	0.003
	NCEG(n=11)	15.12±1.13	15.63±1.23	0.144	G	0.133	0.719
	p_Group	.907	.460		T*G	1.441	0.243
Rt_BF_F	CEG(n=12)	15.08±1.42	16.01±1.18	0.005	T	11.179	0.003
	NCEG(n=11)	15.37±2.24	15.88±1.68	0.115	G	0.015	0.903
	p_Group	.719	.839		T*G	0.940	0.343
Rt_GCM_L_F	CEG(n=12)	16.01±1.40	17.42±1.31	0.002	T	12.116	0.002
	NCEG(n=11)	16.42±1.75	17.01±1.90	0.169	G	0.000	0.999
	p_Group	.544	.560		T*G	2.026	0.169
Rt_TA_F	CEG(n=12)	20.88±2.11	23.51±2.03	0.002	T	11.669	0.003
	NCEG(n=11)	21.40±2.24	22.37±2.20	0.215	G	0.183	0.673
	p_Group	.576	.213		T*G	2.461	0.132

†Mean±standard deviation, CEG: core exercise group, NCEG: non_core exercise group, Rt: right, RF: rectus femoris, BF: biceps femoris, GCM_M: gastrocnemius medial region, GCM_L: gastrocnemius lateral region, TA: tibialis anterior, F: Oscillation frequency (=muscle tone, Hz), T*G: Time*Group, So.: Source

Acknowledgment

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Biography

Hyuk-Jae Choi was born in Wonju, Korea in 1981. He received the Ph.D. degree in sports medicine from the University of Soonchunhyang, in 2019.

Won-Young Lee was born in Seoul, Korea in 1988. He received the Ph.D. degree in Physical Education from the University of Soonchunhyang, in 2018.

In-ho Hwang was born in Incheon, Korea in 1978. He received the Ph.D. degree in Electrical & Electronic Engineering from the Yonsei University in 2017.

Chang-Yong Ko was born in Jeju, Korea in 1979. He received the B.E. degree in biomedical engineering from the Yonsei University, in 2005, and Ph.D. degrees in biomedical engineering from the Yonsei University in 2011.

Sung-Phil Heo received the Ph.D. degree in Information Sciences from Tohoku University, Sendai, Japan, in 2004. Currently, he is a Professor and Center Director of Strategy Planning Center, Gangneung-Wonju National University. His research interests include u-healthcare, IoT/M2M, and wireless communications.

ANN-based Pet Activity Recognition with Wearable Sensors

Heerae Lee¹⁾, Seongyeong Kim¹⁾, and Hyung Gyu Lee^{1,*)}

¹⁾Dept. of Software, Duksung Women's University, Korea

E-mail: hglee@duksung.ac.kr

Abstract: In this study, we use a motion sensor module and ANN (Artificial Neural Network) to recognize and analyze a pet's behavior in real time. The existing home CCTV (Closed-Circuit Television) that recognizes a pet behavior has privacy and security issues, so there is a need for new technologies to overcome these issues. In this paper, we propose a system that can analyze and care for a pet's behavior based on the data measured from the motion sensor which is attached on the body of the pet. The collected data is preprocessed and processed by a ANN-based light-weight classifier to recognize the pet's activity. Our extensive measurement and simulations demonstrate that our model achieves the recognition accuracy of about 82.19%. In addition, the model is lightened to confirm its potential for use in embedded environments.

Keywords : Motion Recognition, Pet Behavior Analysis, ANN (Artificial Neural Network), Sensor

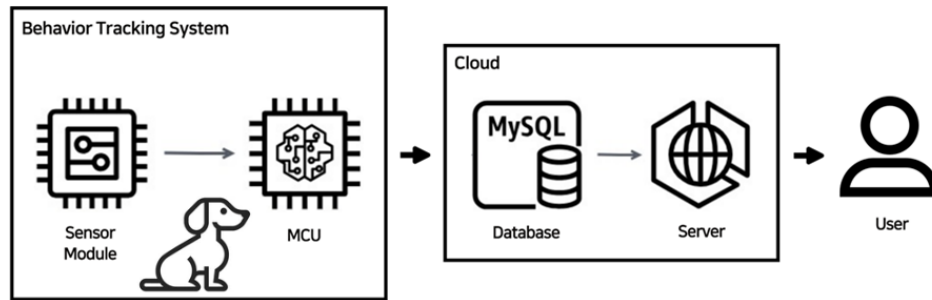


Figure 1. System Architecture

Recently, with the aging population and the increase in single-person households, the pet-related market has expanded, leading to a growing interest in pet care systems [1]. This study mainly propose a simple but effective methodology for pet activity recognition. Since our study is only relied on a wearable sensor attached on the body of the pet without using any camera device, it can completely free from the privacy and security issues[2]. In addition, the recognition can be performed in anyplace the pet goes. Fig. 1 presents the system architecture of the proposed pet activity recognition, which consists of a behavior tracking system and cloud server. The sensor attached on the body of the pet measures the movement data and the data is processed and classified using a light-weight deep-learning model directly executed in a microprocessor in realtime. The activity recognition results are then, transmitted to the cloud server via Internet. Finally user can remotely monitor the pet behaviors using a mobile device.

To find a light-weight but accurate deep learning model customized for pet activity recognition, this study first conducts and compares the MLP (Multi-Layer Perceptron) and CNN (Convolution Neural Network) models. The dataset needed for training the deep learning models, is collected directly from five pet dogs using a motion sensor attached on the top of dog collar. To collect the data and make labels for each set of data, we also develop a tagging application using a smartphone as shown in Fig. 2(a). Totally, 5,312 datasets were collected by categorizing them into 8 behaviors (Standing, Lying down, Sitting, Walking, Slow walking, Running, Eating, Digging) [3]. We optimize the conducted MLP and CNN models to make them light-weight, and finally we achieve 82.19% of recognition accuracy with a simple MLP model (two hidden layers and 109,758 parameters). Finally we develop a monitoring applications as shown in Fig. 2(b).

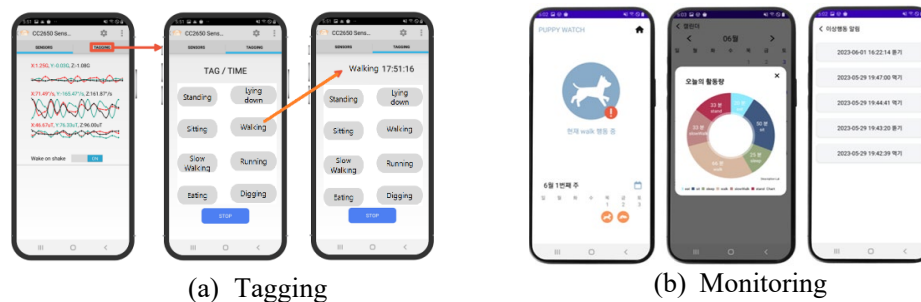


Figure 2. Pet Activity Monitoring Smartphone Application

Acknowledgment

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Biography

Hyung Gyu Lee received the Ph.D. degree in the school of Electrical and Computer Engineering from Seoul National University 2007, and he is an associate professor in the department of Software, Duksung Women's University.

Heerae Lee and Seongyeong Kim are undergraduate students in the department of Software, Duksung Women's University.

SESSION 5
Innovative Solutions in Mobile
Systems and Security
Chair: Hyung Gyu Lee
(Duksung Women's Univ.)

Collaboration-focused Network Design for Return & Collection in a Delivery Services

Muzaffar Makhmudov¹⁾ and Chang Seong Ko^{2,}*

¹⁾**Department of Industrial Management, New Uzbekistan University, Uzbekistan.**

^{2*)}**Department of Industrial and Management Engineering, Korea.**

E-mail: m.makhmudov@newuzbekistanuniversity.uz / csko@ks.ac.kr

Abstract: The COVID-19 pandemic has triggered a massive change in the way people shop, favoring online platforms that offer 'Free Return' options. This change has led to a sharp increase in the number of returns, posing a serious challenge for companies, especially those with less market power. As the market adapts to this situation, the growing number of small and medium-sized delivery companies faces a tough battle against industry giants. These smaller competitors, lacking in financial, infrastructural, and research capabilities, face difficulties in quickly improving their logistics systems and order delivery performance. However, in this context, the opportunity of forming strategic alliances along the value chain appears as a possible solution. Through cooperation, these small and medium-sized enterprises can potentially reduce service costs, improve service quality, and strengthen customer loyalty, allowing them to cope with the competitive environment more effectively. This paper proposes a collaboration model for network design of return collection in the delivery service industry. The model aims to enhance the competitiveness and sustainability of small and medium size delivery companies by sharing their resources and capacities with other partners. This concept is formulated mathematically as multi-objective programming problem with profit maximization of the overall collaboration and incremental profit of each participating company. To check the fairness and sustainability of the profit allocation the research uses cooperative game theory approaches such as Shapley value. The model is applied to a numerical example to demonstrate its applicability and effectiveness.

Keywords: E-commerce, Delivery service, Collaboration, Return Collection, Network design, Sustainability

Operating System Security Vulnerabilities in Autonomous Vehicles

Clint Scholtisek¹⁾, Connor Kreis²⁾, Kamran Siddique^{3,)}, Mengwen Wang⁴⁾,
Yuechun Wang⁵⁾, and Ka Lok Man⁶⁾*

¹⁾²⁾³⁾ University of Alaska Anchorage.

⁴⁾⁵⁾ Sanda University, Shanghai, China.

⁶⁾ Xi'an Jiaotong-Liverpool University, Suzhou, China.

*E-mail: Cvscholtisek@alaska.edu / Chkreis@alaska.edu / Ksiddique@alaska.edu /
Arwenggn@outlook.com / Yuechun.wang@sandau.edu.cn / Ka.Man@xjtlu.edu.cn*

Abstract: Autonomous vehicles are becoming an increasingly popular topic of discussion and are expected to revolutionize automotive transportation. Along with increased interest in autonomous vehicles, the security of these vehicles is a growing concern and at the forefront of the minds of potential buyers. This paper examines potential operating system security vulnerabilities in autonomous vehicles and offers recommendations for improvement. By addressing these vulnerabilities, we can help ensure that autonomous vehicles are safe and secure for drivers and passengers alike.

Results: As technology advances and people become more reliant on technology in their lives, it becomes increasingly important that the capabilities of that technology do not fall into the wrong hands. With self-driving cars quickly rising in popularity, the need for vehicular cyber security is growing along with it. By utilizing microkernel operating system techniques, ROS immunity, and carefully implementing vehicle ad-hoc- networks, we can effectively defend against autonomous vehicle cyber-attacks and help mitigate potential damage to infrastructure, systems, networks, and most importantly, people's lives.

Keywords : Autonomous Vehicle OS, Security Vulnerability, ROS, VANET

Acknowledgment

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An Exploratory Case Study of TempleOS: An Open-Source Lightweight Operating System

Tremayne Booker¹⁾, Mary Kollander²⁾, Puah Jia Hong³⁾, Kamran Siddique^{4,}, Xieyang Zhou⁵⁾, Yuechun Wang⁶⁾, and Ka Lok Man⁷⁾*

¹⁾²⁾³⁾⁴⁾ School of Computer Science and Computer Engineering, University of Alaska Anchorage
Anchorage Alaska, United States

⁵⁾⁶⁾Dept. of Information Science and Technology, Sanda University, Shanghai, China.

⁷⁾ School of Advanced Technology, Xi'an Jiaotong-Liverpool University, Suzhou, China.

E-mail: tebooker@alaska.edu / mgkollander@alaska.edu / puahjh00@gmail.com /
ksiddique@alaska.edu / zxy1518301696@hotmail.com / yuechun.wang@sandau.edu.cn /
ka.man@xjtlu.edu.cn

Abstract: This paper presents an in-depth analysis of TempleOS, an open-source lightweight operating system created by Terry Andrew Davis designed for x86-64 computers. The primary focus of this study is to benchmark the performance of the operating system in the areas of memory management, file I/O operations, and threading. In addition, the paper also offers a comprehensive system overview, including its architecture, kernel design, and user interface. Our quantitative results were measured using a series of primitive and lightweight benchmarking programs translated and ported into TempleOS. Our qualitative analysis was determined by our own observations of TempleOS through a virtual machine. Our study concludes that TempleOS excels in memory allocation speeds yet lacks heavily in file and threading speeds compared to modern operating systems.

Keywords : TempleOS, Lightweight OS

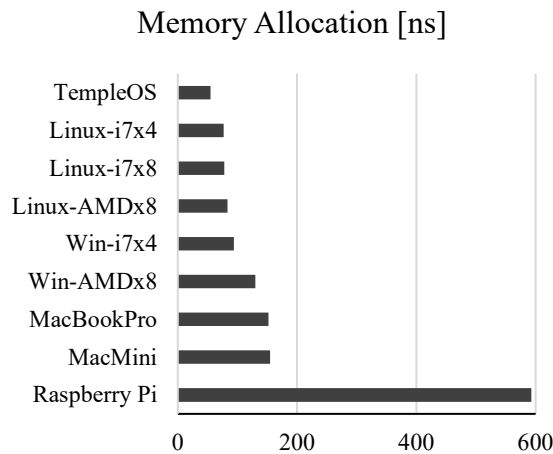


Figure 1. Memory Allocation Times

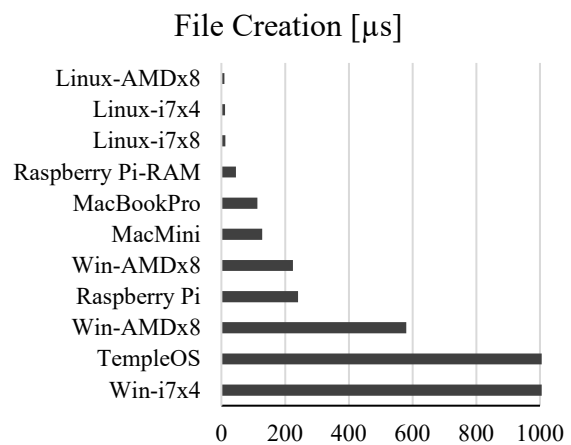


Figure 2. File Creation Time

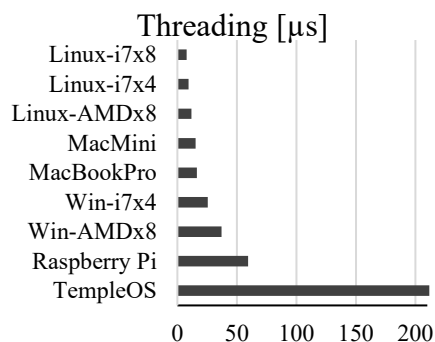


Figure 3. Thread Creation Times

Acknowledgment

This work is partially supported by the XJTLU AI University Research Centre and Jiangsu Province Engineering Research Centre of Data Science and Cognitive Computation at XJTLU. Also, it is partially funded by the Suzhou Municipal Key Laboratory for Intelligent Virtual Engineering (SZS2022004) as well as funding: XJTLU-REF-21-01-002 and XJTLU Key Program Special Fund (KSF-A-17). This work is also partially supported by Sanda University Research Fund under Grant No. 2022BSZX09.

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Design of Blockchain-based Network System for Multi-domain V2G Environments

DeokKyu Kwon¹⁾, Seunghwan Son¹⁾, and Youngho Park^{1,*)}

¹⁾School of Electronic and Electrical Engineering, Kyungpook National University, Korea.

E-mail: kdk145@knu.ac.kr / sonshawn@knu.ac.kr / parkyh@knu.ac.kr

Abstract: Vehicle to grid (V2G) is a technology that efficiently exchanges and manages electric power between electric vehicles (EV) and the grid through bidirectional charging. Through this, EV users can pursue profits by performing energy trading according to electricity prices. Moreover, grid managers can store electricity and provide instant charging services to EV users who need electricity. In real V2G environments, various service providers exist to provide V2G services to EV users. However, the existing V2G network models assume only a single domain. Thus, users of a specific domain with a large number of subscribers cannot properly receive the charging service due to overload in single-domain V2G environments. In this paper, we propose a V2G network system considering multi-domain environments. The proposed network system model uses consortium blockchain to unity multiple single-domains. Moreover, anonymized user information is uploaded to the blockchain to provide secure and seamless V2G services. The proposed network system model is shown in Fig. 1.

Keywords : Blockchain, electric vehicle, multi-domain, vehicle to grid.

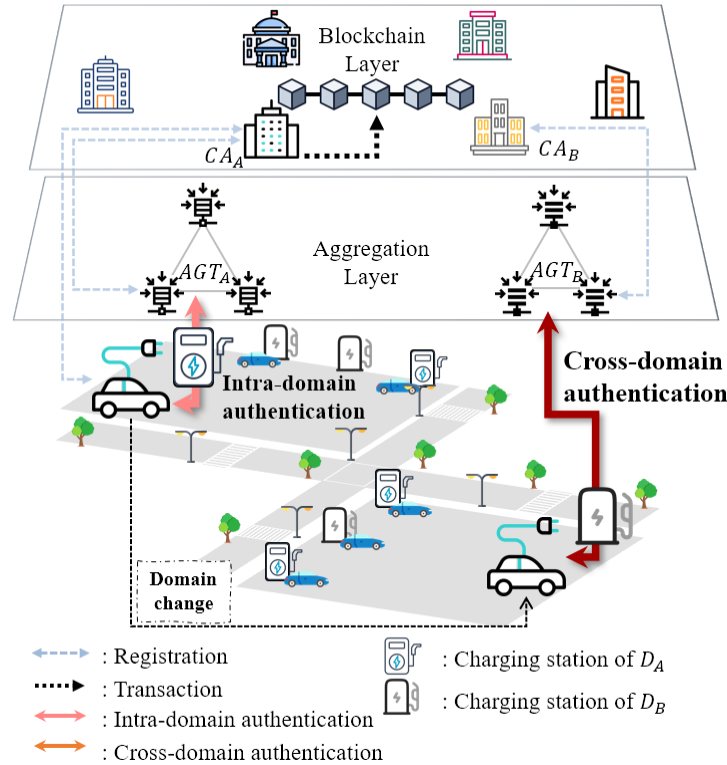


Figure 1. Proposed network system model.

The proposed network system model consists of three layers : Blockchain layer, aggregation layer, and ground layer. In blockchain layer, various certificate authorities (CAs) exists to manage their own V2G service domains. Moreover, CAs are the nodes of consortium blockchain and upload EV user's anonymized information to achieve seamless cross-domain communications. The aggregation layer includes aggregators belonging to the domain, which manage EV users' charging data and provide optimized electric charging services. At the ground layer, EV users can communicate with the

aggregator through the charging station. Even if the EV user does not join the domain, the aggregator can retrieve the anonymized user information from the blockchain and authenticate the EV user. After the authentication process, the EV user and the aggregator generate a session key and perform energy trading services.

In future work, we will propose a secure authentication protocol based on the proposed network system model for multi-domain V2G environments. The authentication protocol will have separate authentication processes for intra-domain and inter-domain communication situations. We will design the authentication protocol using elliptic curve cryptography (ECC) and physically unclonable functions (PUFs) to achieve security robustness and efficiency. Moreover, we will analyze the authentication protocol using various security and performance analysis tool, including Scyther tool, Real-or-Random model, and network simulator 3.

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Biography

Youngho Park received the B.S., M.S., and Ph.D. degrees in electronic engineering from Kyungpook National University, Daegu, South Korea, in 1989, 1991, and 1995, respectively. He is currently a Professor with the School of Electronic and Electrical Engineering, Kyungpook National University.

DeokKyu Kwon received the B.S. degree in electronics engineering from Kyungpook National University, Daegu, South Korea, in 2020. He also received the M.S. degree in Electronic and Electrical Engineering from Kyungpook National University, in 2022. He is currently pursuing the Ph.D. degree with the School of Electronic and Electrical Engineering.

Seunghwan Son received the B.S. degree in mathematics and the M.S. degree in electronic and electrical engineering from Kyungpook National University, Daegu, South Korea, in 2019 and 2021, respectively. He is currently pursuing the Ph.D. degree with the School of Electronic and Electrical Engineering.

Estimating Software Project Performance Using Factor Analysis and Sequential Equation Modeling

Khumoyun Aminaddinov Ravshanovich¹⁾ and Lionel Randall Kharkrang²⁾

¹⁾Dept. of Computer Science, New Uzbekistan University, Uzbekistan.

²⁾Dept. of Physics, National Institute For Astrophysics, University of Trieste, Italy.

E-mail: k.aminaddinov@newuu.uz / bahduh94@gmail.com

Abstract: Project performance is a critical aspect of the software development process or any professional work cycle. However over the years evaluating software projects from source code metrics has been a challenging task for project managers. In this paper we propose a statistical based pipeline for converting original low-level software project source code metrics, such as commit count, into human-readable, interpretable latent factors, such as code quality in order to evaluate performance. We use a dynamic data set, consisting of 1,000 completed and ongoing software projects from Github. We use structural equation modeling (SEM) and Factor Analysis (FA) to extract meaning from the software projects metrics. A p-value less than 10^{-7} was observed from our SEM analysis, and the Eigenvalue versus Factors scree plot (Fig. 1) analysis for FA showed supported evidence of our choice of underlying factors. The performance indicators found using our approach are namely code quality, software developers motivation and software repository maintainability. We demonstrate an easy interpretation of the results gathered from our method (Fig. 2), where a potential software team leader can look back and derive valuable insight into ongoing projects and evaluate the appropriate steps to be taken.

Keywords: Performance Estimation, Factor Analysis, Sequential Equation Modeling

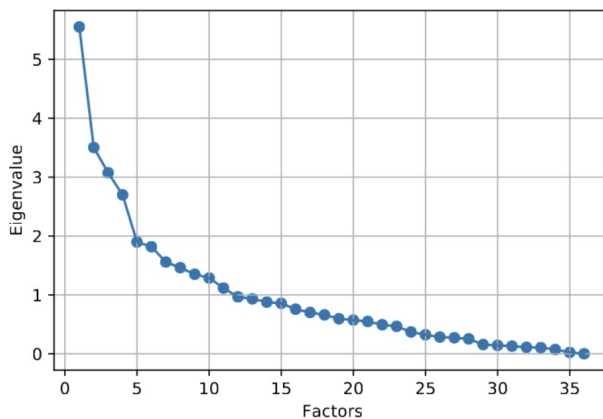


Figure 1. Scree plot

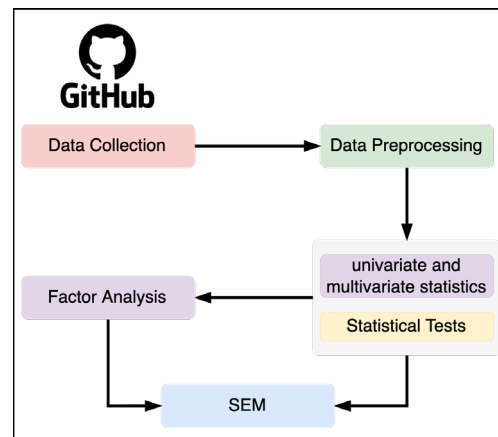


Figure 2. Methodology Schematic Diagram

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Biography

Khumoyun Aminaddinov was born in Karakalpakstan in 1998. He received the B.E. degree in Information Communication Engineering from the Inha University of South Korea, in 2020, and the M.Sc. degree in Data Science from the Innopolis University in 2023. His professional experience includes software development, Internet of Things, Natural Language Processing. During his Master's he joined a research group under supervision of the dean of AI school, where he conducted research on the topic "Fairness in dynamic setting: do neural networks forget to be fair when trained incrementally?". For his thesis, he focused on optimization of small hydropower stations based on the data.

Randall Kharkrang completed his Bachelor's degree in Environmental Science at IISc, focusing his thesis on signal processing of deep seismic signals. He furthered his education by earning a Master's degree in Data Science from Innopolis University, delving into the thesis topic of multimodal Financial Predictive Modelling using Deep Learning techniques. With diverse professional experience spanning Computer Vision, Natural Language Processing (NLP), and Blockchain technologies, Randall now pursues his Ph.D. in Data Science at the University of Trieste. His doctoral research encompasses the investigation of anomaly detection within astronomical datasets, coupled with an in-depth exploration of Bayesian inference techniques, as well as Probabilistic ML as they pertain to applications in astronomy.

Novel Rectifier Circuit for Energy Harvesting for High Output Voltage

Wend Yam Ella Flore NIADA¹⁾ and You Chung CHUNG²⁾

¹⁾Dept. of Electronic Engineering, Daegu University, Korea.

²⁾Dept. of Information and Communication Engineering, Daegu University, Korea.

E-mail: niadaella@daegu.ac.kr

Abstract: A rectifier circuit is studied to harvest the ambient RF power at 2.45 GHz frequency. The circuit comprises a dual branch of one stage of Greinacher rectifier. This study addresses the problem of saturation due to diode threshold voltage. In fact, as the number of diodes used increases the reverse effect can be seen on the output voltage after a certain number of diodes. The results of the simulation of our rectifier show an output voltage of 1V at 2.45 GHz with -15 dBm input power.

Keywords : rectifier, energy harvesting, power combiner

Introduction

In the field of wireless communication and the Internet of Things (IoT), finding sustainable and efficient power sources is crucial. This study explores the use of an RF energy harvesting rectifier merged with two transmission lines to create a rectifying circuit with high output. RF energy harvesting involves capturing and rectifying RF signals, typically in the microwave frequency range, and converting them into DC electricity. However, power conversion can be inefficient when the input power is low, posing a significant challenge for energy harvesting rectifiers. This article explores the synergy between a rectifier and amplifying circuit, demonstrating their combined potential for generating high voltage outputs from harvested RF energy.

Rectifier analysis

The voltage doubler circuit shown in Fig 1 is a crucial component in RF energy harvesting rectifier circuits. It operates on the principle of capacitor charge and discharge and theoretically doubles the input voltage. The circuit is composed of diodes, capacitors, and resistors, making it a compact solution for converting low-voltage RF signals into higher DC voltages. [1] The analysis of voltage doublers involves understanding the interplay between components, capacitor charging cycles, and the resultant voltage multiplication. The input AC voltage is first rectified by a diode in a voltage doubler, resulting in a pulsating DC voltage. This pulsating DC voltage is then fed into a capacitor, which charges to the peak voltage of the rectified waveform. A second diode is used to direct the charged capacitor to a load during the opposite half-cycle of the input signal, effectively doubling the voltage across the load. This circuit works by alternately charging and discharging the capacitor, utilizing both halves of the input signal to achieve a voltage that is twice the peak amplitude of the original AC signal.

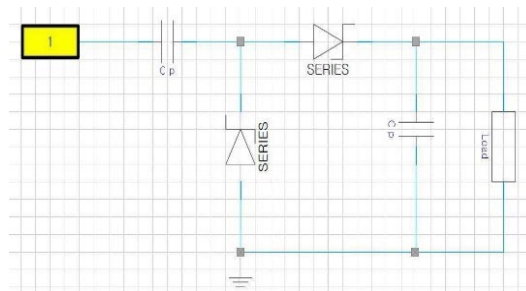


Figure 1. A sample line graph

The authors of [2] introduced a circuit that determines the limit of the number of stages by adding the output voltage of two branches of a voltage multiplier, as shown in Fig. 2. This approach improves

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power conversion efficiency. Their work inspired us to improve their circuit in order to produce higher voltage.

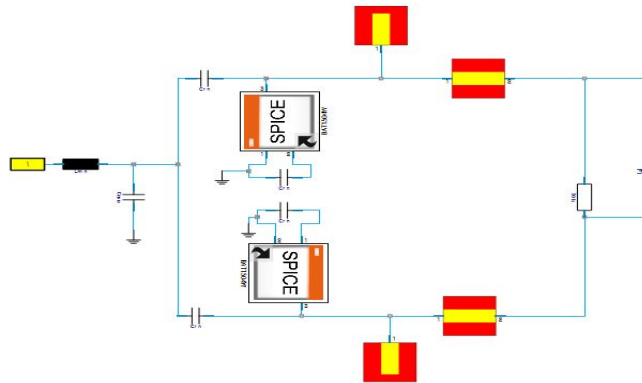


Figure 2. Proposed rectifier circuit

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SESSION 6

Automated Service Impact Analysis

Chair: Min Ho Ryu (Dong-A Univ.)

A Study on the Effect of the Bank's Automatic Call Service

Sohui Kim¹⁾ and Min Ho Ryu^{2,}*

^{1,2)}Dept. of Management Information System, Dong-A Univ, Korea.

E-mail: ryumh12@dau.ac.kr

Abstract: With the proliferation of digital trends, customer approaches to financial services are transforming. In response to digital transformation and the expanded use of non-face-to-face services due to COVID-19, banks are reshaping their customer centers into automated contact centers. This study aims to validate the effects of digital transformation in financial advisory services by examining the differences in success rates between human advisors and auto-calls (Happy Calls) and identifying factors influencing success. To achieve this, chi-square tests and logistic regression analyses were conducted on Auto-call data and customer information from Bank A. The analysis revealed that the success rate of Auto-calls is higher than that of human advisors. Furthermore, seven variables, including the type of advisory scenario, advisory date and time, customer gender, customer age, and experience with non-face-to-face services, were found to significantly impact the success of Happy Calls. This research contributes to the strategic formulation for the digital transformation of banks by utilizing actual banking data for empirical verification.

Keywords : Digital Transformation, Automatic Call, Happy Call, AI

Introduction

The modern financial industry is witnessing a heightened digital transformation competition, driven by the emergence of factors such as open banking, my data services, and internet-based specialized banking, surpassing the intensity seen in other industries. In response, banks are actively engaged in various initiatives, including product recommendations, automated customer interactions, anomaly detection in transactions, and enhancements to credit rating models. The widespread adoption of non-face-to-face services across industries, accelerated by the COVID-19 pandemic, has further accelerated the pace of digital transformation.

Historically, digital transformation efforts have primarily focused on improving operational efficiency and reducing costs. Notably, in the banking sector, there is a significant emphasis on automating customer interactions through the introduction of AI-driven auto-call systems. This collaborative approach with human advisors aims to contribute to branch reduction and the activation of non-face-to-face channels, resulting in substantial benefits compared to the pre-digital transformation era.

However, it is essential to recognize that not all service users universally embrace digital transformation and service automation. According to recent studies, the introduction of artificial intelligence is an expected trend in modern society. However, there are users who still find the technology unfamiliar or inconvenient. Resistance to the idea of technology replacing human roles persists, emphasizing the need for technology to provide customers with familiar and convenient experiences to gain acceptance.

Therefore, this study focuses on evaluating the impact of digital transformation, specifically in the context of the automation of financial advisory services, with a particular emphasis on the success of "Happy Calls." By understanding the effects of digital transformation from the perspective of customer service adoption, this research aims to shed light on the factors contributing to a customer-friendly digital experience. The insights gained from this study are expected to contribute to the formulation of effective digital transformation strategies for banks.

Design

This study utilizes chi-square analysis and logistic regression analysis to investigate the effects of digital transformation on financial advisory services, focusing on the analysis of Happy Call services—a prominent case of collaboration between automatic calls and human advisors. The analysis is based

on data collected from Happy Call services conducted for customers of Local Bank A in Korea during a total of 10 business days in March and April 2023. The dataset comprises information from 9,133 customers. The collected data includes variables related to Happy Call success, service characteristics (execution method, scenario name, product subscription route), time characteristics (day of the week, call time frame), customer characteristics (customer type, gender, age group, residence area), and experience (non-face-to-face service usage experience, product ownership). In total, 12 variables were utilized in the analysis to illuminate the various aspects of the digital transformation impact on financial advisory services.

Acknowledgment

This research was supported/partially supported by Dong-A University. We thank our colleagues from Dong-A University who provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations/conclusions of this paper.

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Biography

Min Ho Ryu was born in Republic of Korea in 1975. He received the B.E. degree in systems management engineering from the Sungkyunkwan University, in 2002, and the M.S. and Ph.D. degrees in electrical engineering from the KAIST in 2004 and 2008, respectively.

Sohui Kim was born in Republic of Korea in 1998. She received the B.E. degree in economics from the Dong-A University, in 2021, and the M.S. degrees in management information system from the Dong-A University in 2023, respectively.

BEACON - Voice Assistant for Visually Impaired People on Windows PC

Truong Quoc Thang^{1,}, Pham Quoc Bao¹, Nguyen Van Vi¹, Than Thi Thao¹,
Nguyen Trieu Tien¹, and Tran Kim Sanh¹*

¹International School, Duy Tan University, Vietnam.
E-mail: contact@beacon.id.vn

Abstract: This project presents the development and implementation of a specialized voice assistant tailored to support visually impaired individuals operating Windows PC systems called Beacon. The voice assistant is designed to enhance accessibility by facilitating seamless interaction with integrated functions, including music playback, news consumption, receiving usage instructions, and volume control, catering to the unique needs of visually impaired users. Notably, the assistant is equipped with support for the Vietnamese language and employs a user intention recognition model based on PhoBERT, and FastAPI, contributing to the accurate interpretation of user commands. Evaluation through testing demonstrates an impressive accuracy rate of up to 90% for the provided test data, showcasing the efficacy of the voice assistant in empowering visually impaired users to navigate and utilize Windows PC functionalities independently and efficiently.

Keywords: Voice Assistant, Visually Impaired, Windows PC Accessibility, User Intention Recognition, PhoBERT-based Interaction.

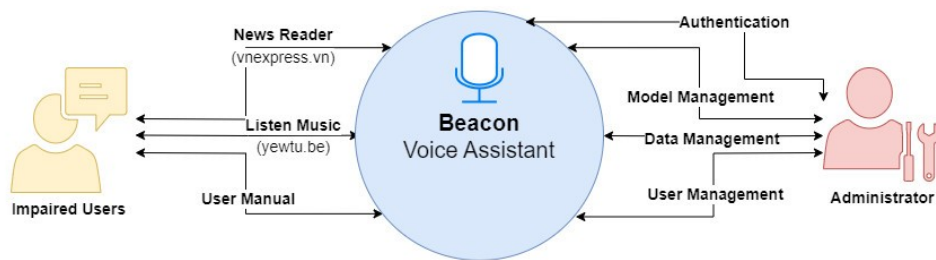


Figure 1. The overall application

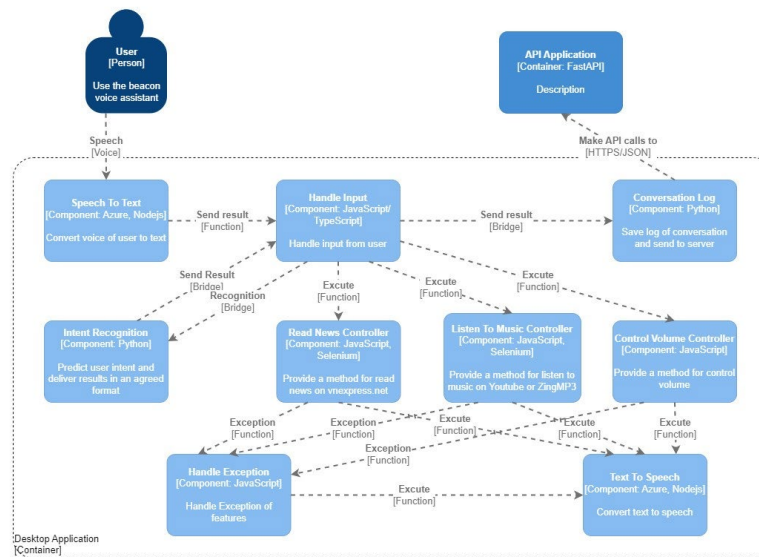


Figure 2. The Architecture of the Application

Results: The application successfully converts and executes user voice commands related to functions such as listening to music, reading the news, and providing usage instructions. It accurately identifies common commands from users with 22 researched and labeled categories, such as `listen_to_music`, `read_news`, `latest_news`, `breaking_news`, etc. The achieved accuracy is over 90% based on the validation dataset.

Acknowledgment

The International School of Duy Tan University supported this research. We thank our colleagues from Duy Tan University who provided insight and expertise that greatly assisted the research.

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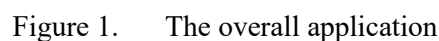
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Biography

Truong Quoc Thang, born on Dec-25, 2000. Currently, I am a final-year student majoring in Software Engineering. My primary focus and research interests are software development and AI. I am passionate about exploring innovative solutions in software development and leveraging AI to create intelligent and efficient systems. As I complete my academic journey, I am excited about contributing to the ever-evolving landscape of technology and software engineering.

¹⁾International School, Duy Tan University, Vietnam.
E-mail: taskcafe.team@gmail.com

Keywords: Online Learning Platform, Content Summarization Tool, Facilitates online learning



Results: This project is the successful development and implementation, a specialized Online Learning Platform equipped with a Content Summarizer. Key results and achievements throughout the project lifecycle are summarized below:

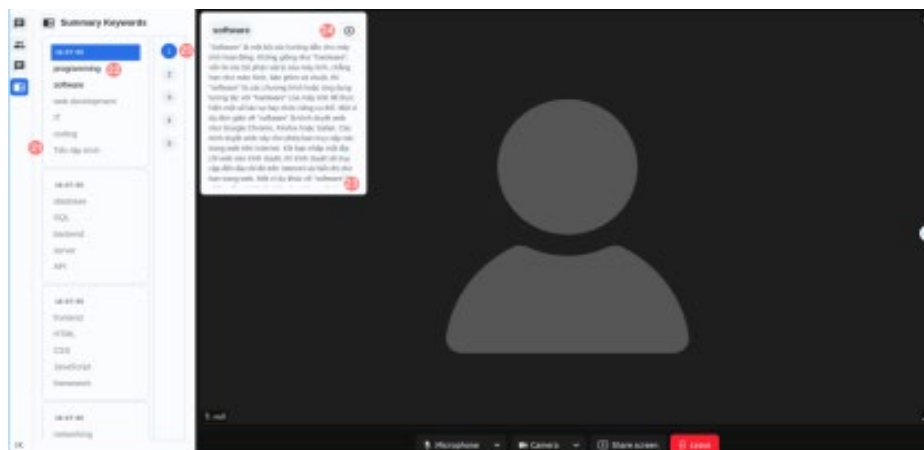
- Specialized Learning Platform: provides a tailored online learning experience for Duy Tan University's Information Technology sector, addressing the unique needs of students and educators in this field.
- Content Summarization Tool: The platform incorporates a sophisticated Content Summarization Tool, enabling the extraction of essential keywords from online lectures. This facilitates efficient note-taking and comprehension, enhancing the overall learning process.
- Tackles the challenges of hybrid learning by offering features like real-time captioning and keyword extraction. These features contribute to a seamless learning experience, bridging the gap between online and in-person education.

Acknowledgment

The International School of Duy Tan University supported this research. We thank our colleagues from Duy Tan University who provided insight and expertise that greatly assisted the research.

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Demo



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Biography

Dang Nhat Minh, am currently a student in the K26 cohort at Duy Tan University. My primary area of interest revolves around the development of an Online Learning Platform integrated with a Content Summarizer. I am enthusiastic about contributing to the dynamic field of technology and software engineering, and eager to be a part of advancements in online education.

Apply Decision Trees Algorithm to Build the Wellness Navigator Management System

Nguyen Huu Vien^{1,}, Tran Duy Tung¹⁾, Do Tien Thanh¹⁾, Vo Van Hao¹⁾, and Tran Thi Thuy Trinh¹⁾*

¹⁾International School, Duy Tan University, Vietnam

E-mail: nguyenhuuvien2064@gmail.com

Abstract: In this project, we are developing an application to assist beginners in their workout routines at the gym. Using a decision tree algorithm, this application provides users with workout and dietary recommendations based on their body metrics. Additionally, it helps users track their workout progress. The test results indicate that the application can make decisions based on the dataset we collected from over 56,000 users to provide personalized recommendations.

Keywords: Health training platform, Facilitates online training.

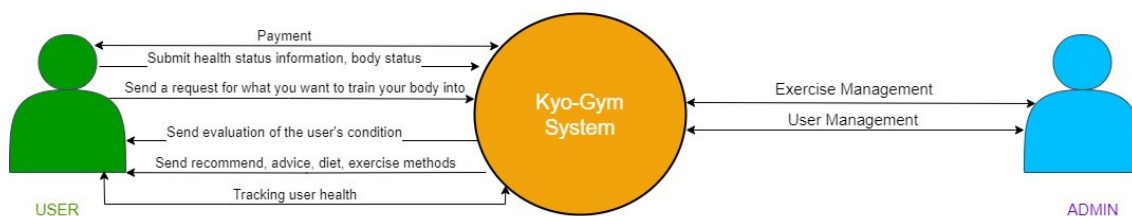


Figure 1. The overall application

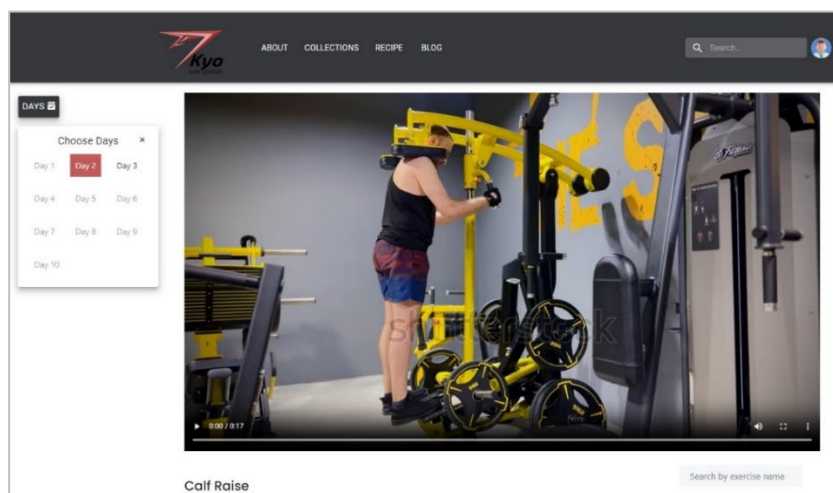


Figure 2. The screenshot of the system

Results:

- **Tailored Recommendations:** The platform employs a decision tree algorithm, analyzing body metrics to deliver personalized workout recommendations, ensuring fitness plans align with individual needs.
- **Comprehensive Training Plans:** Users receive diverse and holistic training plans, addressing various muscle groups and fitness levels, promoting a well-rounded fitness approach.
- **Effective Progress Tracking:** Robust tracking features enable users to monitor achievements, milestones, and areas for improvement, enhancing motivation and consistency.

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- **Health Monitoring:** Regular assessment of body metrics and workout data contributes to overall health monitoring, fostering a proactive attitude towards well-being.
- **High User Satisfaction:** User feedback reflects high satisfaction, emphasizing the platform's personalized approach, diverse training plans, and effective progress tracking, enhancing user commitment to fitness routines.

Acknowledgment

The International School of Duy Tan University supported this research. We thank our colleagues from Duy Tan University who provided insight and expertise that greatly assisted the research.

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4. Tarafdar, Pratik, and Indranil Bose. Recognition of human activities for wellness management using a smartphone and a smartwatch: a boosting approach. *Decision Support Systems* 140 (2021): 113426.

Biography

Nguyen Huu Vien, a final-year student at Duy Tan University, is dedicated to revolutionizing fitness through his innovative online learning app. Passionate about technology and fitness, his project utilizes intelligent algorithms to suggest personalized workout routines while providing robust progress tracking. With a focus on creating a positive lifestyle, He aims to redefine the way individuals' approach and achieve their fitness goals.

Identifying and Extracting Sentiment Words Using Reason-Sentiment Pattern

Woo Hyun Kim¹⁾ and Heejung Lee^{2,*)}

¹⁾Dept. of Industrial Data Engineering, Hanyang University, Korea.

²⁾School of Interdisciplinary Industrial Studies, Hanyang University, Korea.

E-mail: erickbw@hanyang.ac.kr / stdream@hanyang.ac.kr

Abstract: Sentiment analysis is crucial for understanding feelings and opinions in texts like consumer feedback and social media posts. The traditional process of creating sentiment dictionaries, essential for this analysis, faces challenges due to the diverse ways emotions are expressed across different contexts and domains. Our study introduces a new method to streamline this process. We focus on the Korean language and utilize syntax analysis to identify sentiment words through a "Reason-Sentiment Pattern." This pattern separates words that express feelings from those explaining the reasons behind these feelings. Our approach concentrates on words with clear polarity that remain consistent regardless of context or domain, thereby excluding words whose sentiment varies. This method enhances sentiment analysis accuracy, particularly at the attribute level. We validated our approach using Korean cosmetics reviews, showing that a sentiment dictionary based on clear polarity words offers valuable insights for product development, highlighting areas for improvement and strengths. This methodology not only reduces the need for extensive sentiment dictionaries but also ensures high accuracy and versatility across various domains.

Keywords : Aspect-Level Sentiment Analysis, Sentiment Dictionary, Opining Mining

Our study proposes a more efficient approach, focusing on words with clear, consistent polarity regardless of context. This method excludes ambiguous words, simplifying sentiment dictionary construction and enhancing analysis accuracy, especially at the attribute level. The refined sentiment dictionary offers valuable insights for product planning and marketing, as it's easier to update and reuse within the same domain. This approach not only saves time and resources but also improves businesses' understanding of customer needs and expectations from various online texts. For our case study, we used a dataset of 30,000 review data crawled from the Naver online shopping mall site, focusing on cosmetic skin toner products from November 11, 2018, to March 31, 2022. The constructed Korean sentiment dictionary is as shown in Table 1.

Table 1. Korean Sentiment Dictionary

Sentiment words	Polarity	Sentiment words	Polarity
좋다	Positive	부담되다	Negative
ㅎㅎ	Neutral	아쉽다	Negative
만족하다	Positive	놀라다	Neutral
괜찮다	Positive	걱정되다	Negative
모르다	Negative	굿이다	Positive
감사하다	Positive	고민하다	Negative
ㅠㅠ	Neutral	후회하다	Negative
믿다	Positive	안심하다	Positive
기대하다	Positive	답답하다	Negative
추천하다	Positive	고맙다	Positive
나쁘다	Negative	지겹다	Negative
무난하다	Positive	변창하다	Positive

Acknowledgment

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2023S1A5A2A03083440)

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Biography

Heejung Lee received the B.E. degree in industrial engineering from Hanyang University in 1996, and the M.S. and Ph.D. degrees in industrial engineering from KAIST in 1998 and 2007, respectively.

Woo Hyun Kim received the B.E. degree in industrial engineering from Dankook University in 2022 and is currently a master's student in the Department of Industrial Data Engineering at Hanyang University.

SESSION 7
Cutting-edge Medical AI Innovations
Chair: Hyunduk Kim (DGIST)

SS-GAN-ViT: Advancing Multi-label Chest Image Annotation Through Self-Supervised Learning, Adversarial Networks, and Vision Transformers

Sang Suh¹⁾, Sobha Rani Ponduru¹⁾, Nikitha Tammareddy¹⁾, and Bhavana Makkena¹⁾

¹⁾Department of Computer Science, Texas A&M University-Commerce, U.S.A.

E-mail: Sang.Suh@tamuc.edu / sponduru@leomail.tamuc.edu / tsainikitha@leomail.tamuc.edu / bmakkena@leomail.tamuc.edu

Abstract: The swift advancements in medical imaging highlight the need for robust automated multi-label annotation systems, particularly in chest imaging, crucial for diagnosing and monitoring various thoracic diseases. Despite the adoption of deep learning models for image annotation, accurately annotating multiple conditions in chest images remains challenging. A noteworthy attempt, the adversarial-based denoising autoencoder model, showed promise in multi-label classification but had limitations in accuracy and robustness. Motivated by this, we propose the SS-GAN-ViT model, melding self-supervised learning, adversarial networks, and Vision Transformers to significantly enhance multi-label annotation accuracy in chest imaging. This novel amalgamation aims to address the identified limitations of existing models, offering a robust solution for accurate multi-label annotation. Anticipated comparative evaluations with existing models are expected to showcase the superior performance of SS-GAN-ViT, advancing the field of medical image annotation and potentially aiding better diagnostic and treatment planning in healthcare.

Introduction

In recent years, medical imaging has grown significantly due to major advancements in Information Technology (IT) and Artificial Intelligence (AI) [1], [2], [3]. These advancements have ushered in smart healthcare solutions, enabling early detection and accurate diagnosis of various diseases like lung cancer and pneumonia. 2023; Among these advancements, Medical Image Annotation (MIA) plays a key role by providing a detailed analysis of medical images. It helps in identifying organ abnormalities, locating them accurately, and categorizing them, which not only enhances the understanding of medical images but also provides medical practitioners with valuable insights, thereby improving the decision-making process in clinical settings [4], [5].

The rise in Natural Language Processing (NLP) and deep learning technologies has enabled automatic description generation for natural images, highlighting the possibility of automated medical image annotation [6], [7], [8], [9]. Early works in this field have laid a strong groundwork, with models like MC-MIA demonstrating the effectiveness of adversarial-based denoising autoencoders for this task. Yet, chest image annotation is challenging due to chest anatomy complexities and the need for accurate annotation for diagnosis. These issues emphasize the need for innovative models capable of handling complex label correlations in chest images, thereby improving the accuracy and usefulness of chest image annotation.

Motivated by this need, we propose a new multi-label classification framework, SS-GAN-ViT, which combines Self-Supervised GANs and Vision Transformers for improved chest image annotation. This initiative is spurred by the promise of self-supervised learning in identifying complex label correlations [10], adversarial networks in optimizing the delineation of these correlations, and Vision Transformers in handling Our proposed model, SS-GAN-ViT, aims to significantly enhance the accuracy of chest image annotation by effectively navigating complex label correlations, addressing a crucial gap in current medical image annotation models. It is carefully designed to tackle the unique challenges of chest images, advancing towards the broader goal of improving clinical decision-making through accurate chest image annotation.

The SS-GAN-ViT model, tested on the NIH Chest X-ray Dataset, shows notable improvement in annotation accuracy over existing models. This thorough validation highlights SS-GAN-ViT's potential as a strong solution for chest image annotation, contributing significantly to medical image analysis.

This research not only advances the current state-of-the-art in chest image annotation but also sets a solid base for future work in this vital area.

The following sections of this paper are arranged to thoroughly explain our proposed research. Section 2 explores the literature survey, highlighting current models and their limitations [11]

Results: Our exploration into the NIH chest X-ray dataset for disease classification, summarized in Table 1, showcases the SS-GAN + ViT model's superior AUC (Area Under the Curve) and F1 Score, outperforming the baseline EfficientNet B4, SS-GAN with EfficientNet B4, and ViT alone. This data demonstrates the efficacy of our integrated approach in a complex multi-label classification task. Figure 2 provides a visual representation of this analysis, displaying the predictive capabilities of our model against actual diagnostic labels, further illustrating the enhanced performance and accuracy in disease detection.

Table 1. Comparative Performance Metrics

Model	AUC	F1 Score
Efficient b4	0.856	0.232
SSGAN Efficient b4	0.887	0.33
ViT	0.885	0.374
SSGAN ViT	0.905	0.513

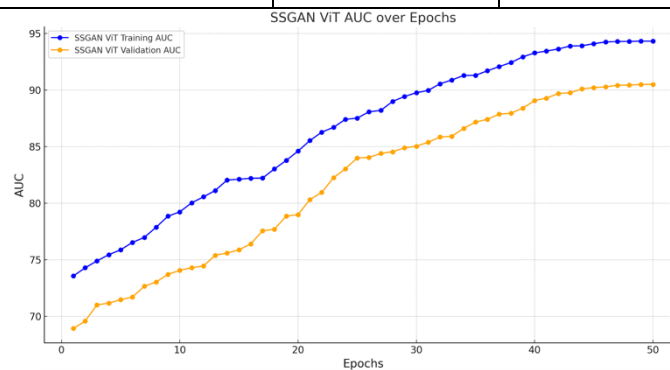


Figure 1. Training and Validation AUC (Area Under the Curve) of SS-GAN ViT Model Over Epochs

Comparative Analysis: When placed alongside findings from previous studies on the NIH dataset, our models performed admirably. For instance, the VDSNet framework reported a validation accuracy of 73% which, when compared to the significant increase in AUC (Area Under the Curve) provided by our SS-GAN integrated models, suggests a substantial improvement in disease classification capability [12].

In another study, deep neural networks targeting tuberculosis achieved an AUC (Area Under the Curve) of 0.83, which is comparable to the AUC (Area Under the Curve) of our baseline Efficient Net model. However, the enhanced models with SS-GAN integration surpassed this, indicating a potential for better discrimination between disease classes [13].

Furthermore, various CNNs including ResNet18 assessed on the NIH dataset achieved AUCs (Area Under the Curves) over 0.96, with ResNet18 reaching up to 0.9824. While these AUCs (Area Under the Curves) are higher than those achieved by our models, it is important to note that these figures were obtained from models trained for binary classification tasks, as opposed to our multi-label classification challenge, which is inherently more complex and prone to lower performance metrics [14]. For a detailed comparison of model performances, refer to Table 2.

Table 2. Comparative Performance of Deep Learning Models on the NIH Chest X-ray Dataset

Study/Model	Metric	Value	Comparision to our work
EfficientNet B4	AUC	0.856	Baseline
SSGAN + EfficientNet B4	AUC	0.887	Improved over baseline
ViT	AUC	0.885	Baseline
ResNet18 (Binary Classification)	AUC	0.9824	Higher than ours, but for binary classification
VDSNet Framework	Accuracy	73%	Lower than our best ROC

DNN for Tuberculosis	AUC	0.83	Comparable to our baseline EfficientNet
SSGAN + ViT	AUC	0.905	Best Performance in our study

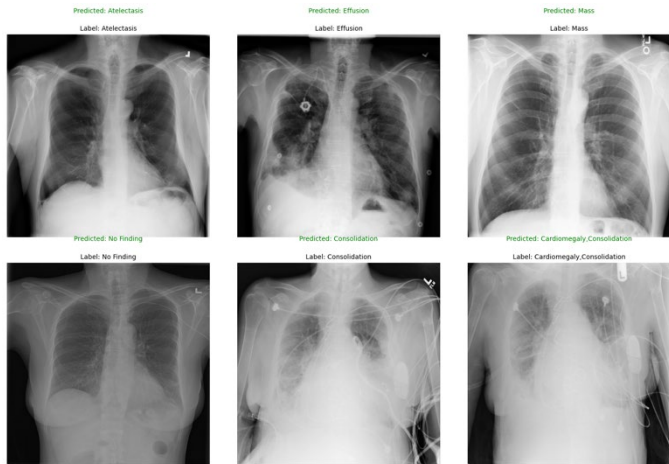


Figure 2. Chest X-ray Analysis: Predictive Diagnosis vs. Actual Pathological Findings

Analysis and Discussion

Table 3. Compares the SS-GAN + ViT model with other models across key criteria, highlighting its superior performance in areas like multi-label classification and learning from unlabeled data.

Criteria/Model	SS-GAN + ViT	EfficientNet B4	ResNet18	VDSNet Framework	DNN for Tuberculosis
Multi-label Classification	✓	✓	✗	✗	✗
Learning from Unlabeled Data	✓	✗	✗	✗	✗
Synthetic Data Generation	✓	✗	✗	✗	✗
Global Dependency Capture	✓	✗	✗	✗	✗
Data Augmentation Capabilities	✓	✓	✓	✗	✗
Adaptability to New Domains	✓	✓	✓	✗	✗

The SS-GAN + ViT model demonstrates a trajectory of consistent improvement and adaptability, as captured by the ascending AUC (Area Under the Curve) values depicted in Figure 1. This graph not only marks the highest AUC (Area Under the Curve) achievement at 0.905 but also reflects the model's stability and learning efficiency throughout the training and validation phases across 50 epochs. Table 3 offers a comparative perspective, affirming the model's distinguished capabilities in multi-label classification and its adeptness at leveraging unlabeled data, which is substantiated by a notable F1 Score of 0.513. These results underscore the SS-GAN + ViT model's advanced feature extraction capabilities, owing to the SS-GAN component, and the refined attention mechanisms inherent to the ViT architecture. Such attributes are particularly beneficial for the NIH chest X-ray dataset, which presents a wide spectrum of pathologies.

During the implementation, we encountered challenges related to the balancing of the generator and discriminator in the SS-GAN, a common issue within GAN frameworks. Additionally, fine-tuning the ViT for the specific nuances of the medical imaging data required meticulous parameter adjustments.

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Medichat - A Medical Chatbot with Multilingual Support

Sang Suh¹⁾ and Rama Krishna Kamma²⁾

^{1,2)}Department of Computer Science, Texas A&M University - Commerce, U.S.A.

E-mail: Sang.Suh@tamuc.edu, rkamma2@leomail.tamuc.edu

Abstract: In the rapidly evolving realm of AI-driven medical consultations, linguistic inclusivity is paramount. The exchanges between patients and doctors obtained from a popular internet resource for medical consultations. In AI-driven medical consultations, the lack of multilingual support in online platforms for patient-doctor interactions poses a significant challenge to achieving linguistic inclusivity. This project introduces Medichat, a revolutionary platform designed to enhance the accessibility, comprehensibility, and reliability of medical advice. By fine-tuning language models, integrating multilingual support, and implementing a self-directed information retrieval system, Medichat empowers users with a universal and secure tool for healthcare guidance. The model's responsiveness is significantly improved through real-time data retrieval from trusted sources, while privacy concerns are addressed with anonymized patient-doctor interactions. Moreover, the project achieves multilingual accessibility by integrating a high-precision translation model and successfully leverages the strengths of various AI components. Medichat represents a significant leap forward in medical AI, offering a comprehensive and inclusive solution for modern healthcare challenges.

Keywords: Chatbot, Artificial Intelligence, Medical

Introduction

A medical chatbot represents a technological marvel, a software creation endowed with artificial intelligence [1] [2] and the prowess of natural language processing [3]. Its mission? To act as a virtual medical guide, extending a helping hand to users navigating the intricate complex of health-related queries. These digital companions excel in deciphering symptoms, suggesting potential maladies, offering insights into treatment options and lifestyle adjustments, and even give pearls of wisdom regarding overall well-being. They're the genie in the healthcare lamp, capable of aiding users in locating nearby healthcare havens or securing coveted appointments [9]. Operating seamlessly across various digital domains like messaging apps, social media realms, and web-based platforms, medical chatbots possess an inherent user friendliness and interactivity [5], that closely mirrors human conversation. They form part of a broader trend aimed at elevating the realm of healthcare services and ameliorating the patient's journey.

As illuminated by Peter Luba [10], these ingenious bots undertake a multifaceted mission encompassing appointment scheduling, healthcare facility reconnaissance, and even encouragement to participate in clinical trials [4]. Increasingly, medical chatbots are taking on the roles of initial symptom scrutineers and expert triage consultants [5]. They engage patients in dialogue, probing for relevant symptom related details and offering preliminary insights into potential diagnoses. The next logical step? Guiding the user towards arranging appointments with healthcare professionals, ensuring that the journey from ailment to remedy is a seamless one. A shining example of this digital healthcare frontier is the chatbot Ada Health [11], which deftly guides users towards a diagnosis based on their symptoms and prescribes the next steps to take. But the prowess of medical chatbots extends beyond these initial interactions. They are quick learners, absorbing user data through the magic of machine learning algorithms, allowing them to tailor responses to individual preferences [6]. By harnessing the incredible capabilities of artificial intelligence and natural language processing, these chatbots constantly refine their ability to comprehend and generate human-like language, ultimately delivering more effective responses to user queries.

In the realm of chatbot implementation, several pivotal phases of Language Processing (NLP) [7] [8] reign supreme. Tokenization takes the lead, converting a stream of characters into a harmonious symphony of tokens. These tokens could be identifiers, words, numerals, or punctuation marks, each getting the lowercase treatment. Then comes the art of stemming, where word variations are harmonized into simpler, root words, guided by the wisdom of language dictionaries. Finally, the tokens find their

place through sorting, meticulously arranged based on shared properties or sorted according to a specific criterion.

The medical field, characterized by its intricate terminologies, necessitates clear and universally accessible communication. While there have been significant strides in AI-driven medical consultations, a substantial segment of the global population remains potentially underserved due to language barriers. This project seeks to bridge this gap by incorporating multi-lingual support, ensuring that accurate medical advice is available to all, irrespective of their linguistic background.

Results: Figure 1 displays the outputs generated by ChatGPT and ChatDoctor in response to a given input. Notably, ChatGPT provided a comprehensive but broad response regarding otitis, while ChatDoctor offered a more targeted answer, emphasizing the application of external knowledge from the brain to treat otitis. However, from Figure 2 and Figure 3 MediChat surpassed both ChatGPT and ChatDoctor in terms of precision, delivering a step-by-step and lucid explanation for the queried topic. This underscores the superior performance of MediChat, showcasing its ability to provide a more detailed and accurate response compared to its counterparts.

MediChat exhibits a remarkable multilingual capability by seamlessly processing input from 200 different languages and delivering output in the same language. This versatility allows MediChat to provide responses in various linguistic contexts, ensuring effective communication across a wide spectrum of language preferences. As demonstrated by a sample output in French (From Figure 4), Spanish (Figure 5) and Portuguese (Figure 6) MediChat's proficiency extends beyond a singular language, emphasizing its ability to cater to diverse linguistic needs with ease and accuracy.

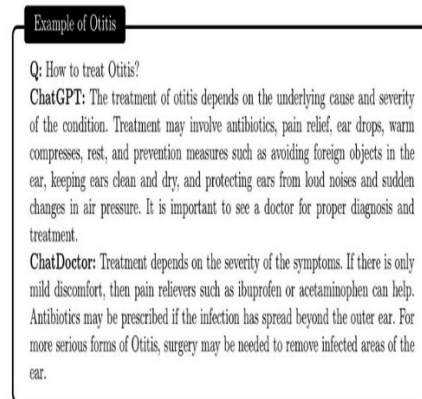
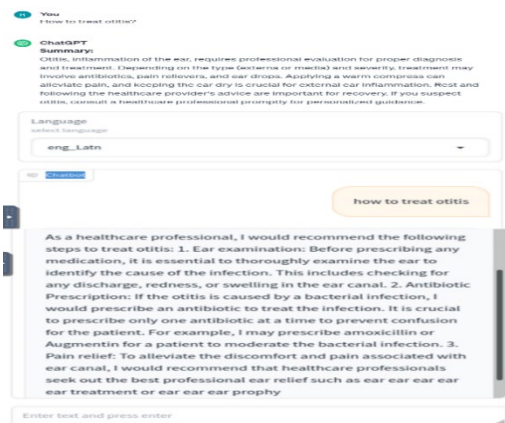


Figure 1. Comparison of ChatGPT vs Ours (Medichat) Figure 2. Sample output from ChatGPT and ChatDoctor

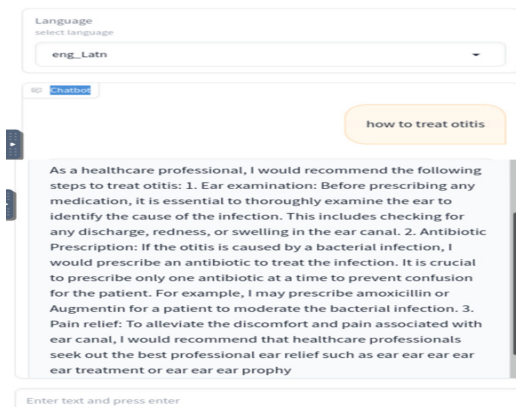


Figure 3. Sample output of Medichat in French

Figure 4. Sample output of Medichat in English

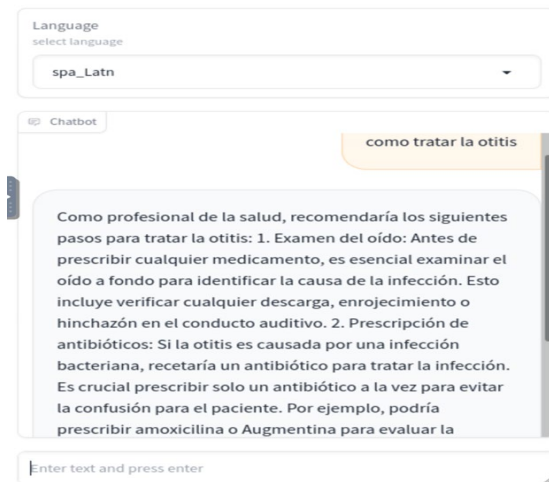


Figure 5. Sample output of Medichat in

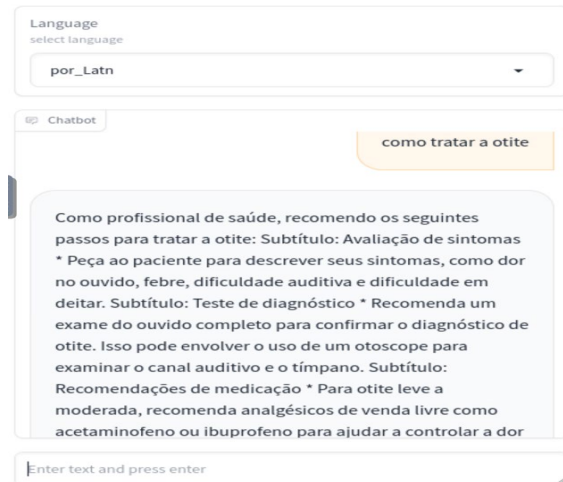


Figure 6. Sample output of Medichat in Portuguese

Conclusion and Future Works: In parallel, worked diligently on the front-end development, with a keen focus on optimizing the user experience. Ensuring that the interface is intuitive and accessible is our top priority, as we aim to provide users with seamless interaction with the models and their outputs. However, some issues have arisen during this process. Notably, the front-end interface has been deemed less user- friendly, impacting the overall user experience. In response, we have initiated improvements in the front-end design to enhance usability, striving to create an intuitive interface that facilitates easy interaction is shown in Figure 6.

Furthermore, the time taken to generate text on CPU has proven to be excessively long, approximately 30 minutes. To address this issue, we are actively exploring strategies to decrease text generation time. This includes considerations such as optimizing algorithms, parallelizing processes, and potentially acquiring a GPU server for faster processing. Our goal is to identify and implement the most efficient and cost-effective solution to significantly improve overall performance, ensuring that users receive timely and reliable responses from the system.

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Visualization Tool: Exploring COVID-19 Data

Donghyun Jeon,^{1,}, Jong Kwan Lee¹, Prabal Dhaubhadel¹, and Aaron Kuhlman¹*

¹Dept. of Computer Science, Bowling Green State University, U.S.A.

E-mail: djeon@bgsu.edu / eej@bgsu.edu / pdhaubh@bgsu.edu / kuhlmaa@bgsu.edu

Abstract: The ability to effectively visualize data is crucial in the contemporary world where information is often voluminous and complex. Visualizations, such as charts, graphs, and maps, provide an intuitive and easily understandable means to interpret, analyze, and communicate patterns, trends, and insights hidden within large datasets. These graphical representations can help researchers, policymakers, and the public to better comprehend and respond to a multitude of issues. In this study, we explore a visualization tool to interpret and understand various data of COVID-19 pandemic.

While others have shown COVID-19 visualization methods/tools (e.g., [1]), our tool provides a mean to analyze COVID-19 data in a more comprehensive way. We have used the public data from NY Times [3] and CDC [4], and various COVID-19 data (e.g., core places, patterns, foot traffic) from Safegraph [5]. Figure 1 shows the basic view of our visualization view. In addition to providing visualizations of these data, our visualization also considered the Surprising Map [2]. The Surprising Map is a type of choropleth map that can avoid misleading of producing visual prominence to known base rates or to artifacts of sample size and normalization in visualizing the density of events in spatial data. It is based on Bayesian surprise—it creates a space of equi-plausible models and uses Bayesian updating to re-estimate their plausibility based on individual events.

Keywords: Visualization; Surprising Map; COVID-19; Safegraph Data;

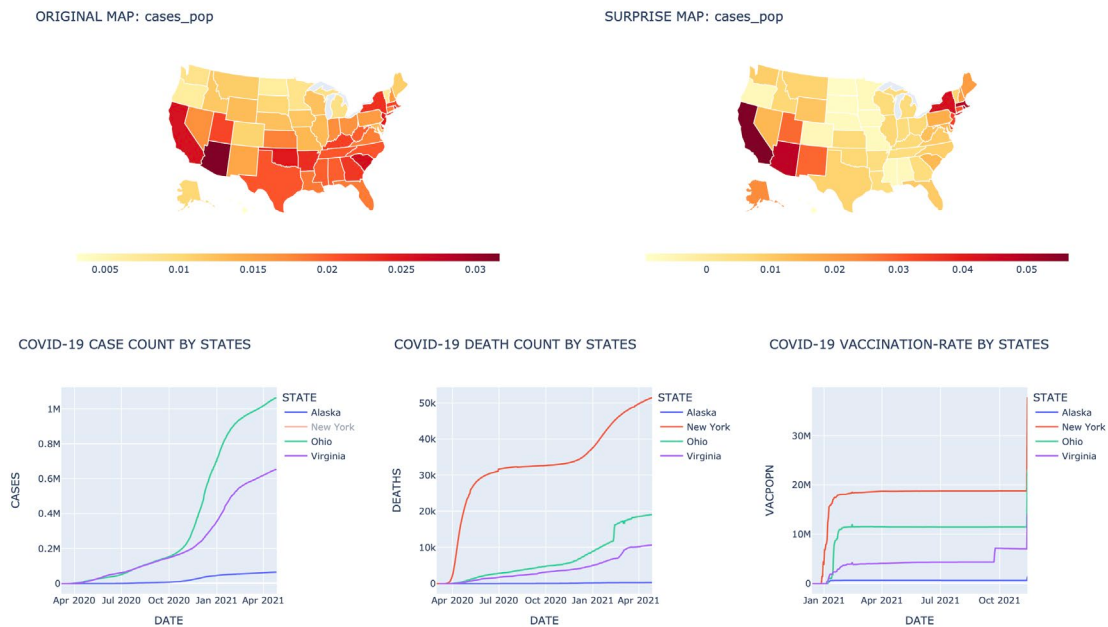


Figure 1. Visualization Tool: Exploring COVID-19 Data (basic view)

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Biography

DONGHYUN JEON received a B.S. degree in Computer Information Systems from State University of New York at Fredonia and a M.S. in Technology Management from University of Illinois Urbana-Champaign. He is currently pursuing a Ph.D. in Data Science at the Bowling Green State University.

JONG KWAN LEE received a B.S. degree in Electronic and Electrical Engineering from Kyungpook National University, Korea. He received M.S. and Ph.D. degrees in Computer Science from the University of Alabama in Huntsville. Currently, he is with the Department of Computer Science at the Bowling Green State University. His research interests include pattern recognition/computer vision, visualization, image processing, and machine learning applications.

PRABAL DHAUBHADEL received a bachelor's degree in Computer Engineering from Kathmandu Engineering College and a M.S. degree in Computer Science from the Bowling Green State University.

AARON KUHLMAN received a B.A. degree in Political Sciences with a minor in Statistics and a M.S. degree in Computer Science from the Bowling Green State University.

Research on human 2D edge sample point to 3D mesh coordinate conversion

Junkwang Kim¹, Myoung-Kyu Sohn¹, Sang-Heon Lee¹, and Hyunduk Kim¹

¹Division of Automotive Technology, DGIST, Daegu, Korea

E-mail: kjk1208@dgist.ac.kr / smk@dgist.ac.kr / pobbylee@dgist.ac.kr / hyunduk00@dgist.ac.kr

Abstract: 3D human body modeling has become an important research topic to provide user-friendly interfaces in a variety of applications. In this paper, we propose a new network to concisely generate a 3D model of the human body based on sample points of human edges in frontal and side images. We utilize the SMPL dataset to sample the silhouette's outline and learn the mapping between the silhouette and the 3D model using a neural network. In this paper, we introduced an augmentation method for 3D scan data and performed learning using it. In addition, we analyzed the impact of the coordinates of SMPL vertices and joint theta with respect to beta on learning. This approach paves the way for potential applications in areas such as virtual fitting, custom design, and physical health monitoring through 3D human modeling.

Keywords : mesh generation, human body modeling, deep learning

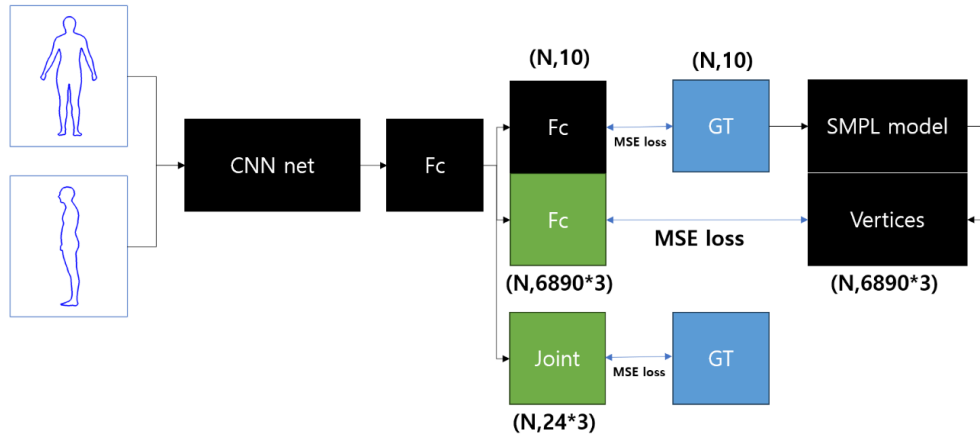


Figure 1. Overall architecture of human body modeling network

In this research, the network's input data was obtained by sampling the outlines of the silhouettes from frontal and lateral images. The input data has a dimension of $(2, 650)$, where '2' represents the x, y coordinates, and '650' indicates the number of sampled points. Given that the input data comprises coordinate values rather than images, a feature extraction layer was constructed using a $\text{Conv}(3,1)$ layer to extract characteristics between adjacent points. After each Conv layer, features were further simplified through the application of BatchNorm and ReLU layers. In the final output stage, the 10-dimensional betas used in the SMPL model were concatenated with the theta values for the 6890×3 -dimensional vertices and joints (27×3). Furthermore, we analyzed the impact of MSE loss for vertices and joints on the estimation of betas. The size of the final output stage is $(B, 20,752)$, where B denotes the batch size.

Acknowledgment

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Biography

Junkwang Kim received a B.S. degree in Computer Science from Keimyung University, Daegu, Korea in 2013 and an M.S. degree in Mobile Communication Engineering from Kyungpook National University, Daegu, Korea in 2018. He is now an associate researcher at Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea, joined in 2013. His research interests include artificial intelligence and detection.

Myoung-Kyu Sohn received a B.S. degree in Electrical Engineering from Kyungpook National University, Daegu, Korea in 1997, an M.S. degree in Electrical Engineering and Computer Science from Seoul National University, Seoul, Korea in 1999, and a Ph.D. degree in Electrical Engineering from Kyungpook National University in 2017. He is now a senior researcher at Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea, joined in 2005. His research focus is deep learning and computer vision for human-computer interface.

Sang-Heon Lee received a B.S. and M.S. degree in Electronics from Kyungpook National University, Daegu, Korea in 1993 and 1996. He also received a Ph.D. degree in Electrical Engineering and Computer Science from Kyungpook National University in 2013. He is interested in Deep Learning and Image Recognition and has been serving as a principal research scientist at Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea since 2005.

Hyunduk Kim received a B.S. degree in Mathematics from Kyungpook National University, Daegu, Korea in 2009 and an M.S. degree in Applied Mathematics from Kyungpook National University, Daegu, Korea in 2012. He is now an associate researcher at Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea, joined in 2012. His research interests include artificial intelligence and face analysis.

Remote Heart Rate Estimation using Swin Transformer V2 and Wrapping Temporal Shift Modules

Hyunduk Kim¹⁾, Sang-Heon Lee¹⁾, Myoung-Kyu Sohn¹⁾, and Junkwang Kim¹⁾

¹⁾Division of Automotive Technology, DGIST, Daegu, Korea.

E-mail: hyunduk00@dgist.ac.kr / pobbylee@dgist.ac.kr / smk@dgist.ac.kr / kjk1208@dgist.ac.kr

Abstract: Heart rate is an important physiological signal that reflects the physical state of a person and widely applied to medicine, sports, and healthcare applications. Heart rate is usually got by electrocardiogram (ECG) and photoplethysmogram (PPG) that requires commonly contact with a subject's skin which may be inconvenient. Hence, many researchers have introduced remote heart rate (rHR) estimation algorithms from face video. In this paper, we introduce a remote heart rate (rHR) estimation algorithm using Swin Transformer V2 and Wrapping Temporal Shift Modules (WTSM). To evaluate the performance of the proposed algorithm, we train and test on the public UBFC-rPPG and PURE dataset. The experimental results show that the proposed algorithm achieve better accuracy than CNN based methods.

Keywords: Remote Heart Rate Estimation, Vision Transformer, Temporal Shift Modules

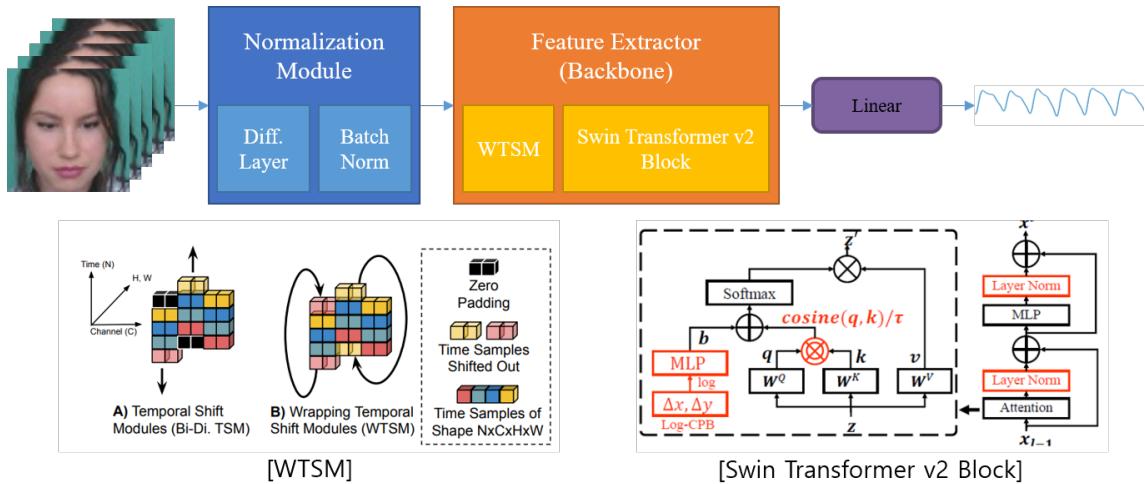


Figure 1. Overall architecture for remote heart rate estimation.

In this paper, we propose remote heart rate estimation using Swin Transformer v2. Moreover, we add Wrapping Temporal Shift Module (WTSM) before Swin Transformer v2 block to facilitate information exchange across the temporal axis. The original videos are firstly preprocessed to crop the face to get the face video. Then we fed 160 face sequences to Normalization Module, which consists of different layer and batch normalization layer. Then, we extract spatiotemporal representation using WTSM and Swin Transformer V2 and estimate the PPG signal using Linear layer. Finally, we calculate heart rate using FFT. Figure 1 shows the structure of the proposed remote heart rate estimation algorithm.

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This work was supported by the DGIST R&D Program of the Ministry of Science and ICT (23-IT-02).

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Biography

Hyunduk Kim received a B.S. degree in Mathematics from Kyungpook National University, Daegu, Korea in 2009 and an M.S. degree in Applied Mathematics from Kyungpook National University, Daegu, Korea in 2012. He is now an associate researcher at Daegu Gyeongbuk Institute of Science and Technology, Daegu, Korea, joined in 2012. His research interests include artificial intelligence and face analysis.

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Using Deep Learning to Determine Time and Geographic Trends of Sentiments Towards Covid-19 Vaccine

Alex A. Diola^{1,} and Robert R. Roxas²*

^{1, 2}Dept. of Computer Science, University of the Philippines Cebu, Philippines.

E-mail: aadiola@alum.up.edu.ph

Abstract: Vaccine hesitancy is one of the challenges faced in the battle against the Covid-19 pandemic [1]. Understanding the sentiments of the public regarding Covid-19 vaccine across various locations throughout the pandemic will allow policy makers to better craft vaccine rollout plans [2][3]. This paper examines the use of deep learning models [4][5] to analyze sentiments towards Covid-19 vaccine [6] using Twitter data to analyze time and geographic trends. Twitter Tweets were used as data of this study collected by a loop-scraping strategy. Data was filtered from January 1, 2020 to December 31, 2022 for a total of 1,096 days. A random sample of 10,000 tweets was manually annotated for model development as positive, neutral, or negative, and the rest is left as operational data. Data preprocessing was composed of data cleaning and word embedding generation. Data Cleaning was done using Natural Language Toolkit (NLTK) Python library. The embeddings were generated using the word2vec algorithm.

The deep learning models used were Simple Recurrent Neural Network (RNN), Long Short-Term Memory (LSTM), and Gated Recurrent Unit (GRU). The same architecture was utilized for all three models. Repeated architecture trial and testing was done to find the best architecture. Hyperparameters were tuned through repetitive testing. The performance metrics used were accuracy, precision, and recall. After model development, the operational data was fed to the models. All three models were used in the operationalization and a voting method was used to determine the final sentiment classification. The voting power of the model was determined by their validation accuracy. After classification of operational data, these were subjected to trend analysis using a time graph and a geo map.

Fig. 1a shows the time graph, where it could be seen that the trend was generally similar between positive and negative sentiments. Although these two classes vary in intensity, the sudden increase of one was almost immediately preceded or followed by the sudden increase in the other. The same trend was for decreases in intensity. The neutral sentiment, however, showed a more consistent and stable trend throughout. Fig. 1b shows the geo map, where it shows a small amount of data points. This could be attributed to the lack of location information of some tweets. The clustering of data points in some areas only and severe lack of data points in others emphasized that sentiments in some areas were not represented, or just simply non-existent. There was a greater cluster of sentiments in the NCR area and much less in the Visayas and Mindanao areas.

The LSTM model achieved 61% accuracy, the GRU model achieved 60% accuracy, and the simple RNN achieved 48% accuracy. The time graph showed that the sentiments varied in quantity but generally exhibited the same trend behavior.

Keywords : Covid-19 Vaccine; Deep Learning; Geographic Trend; Sentiment Analysis; Time Trend

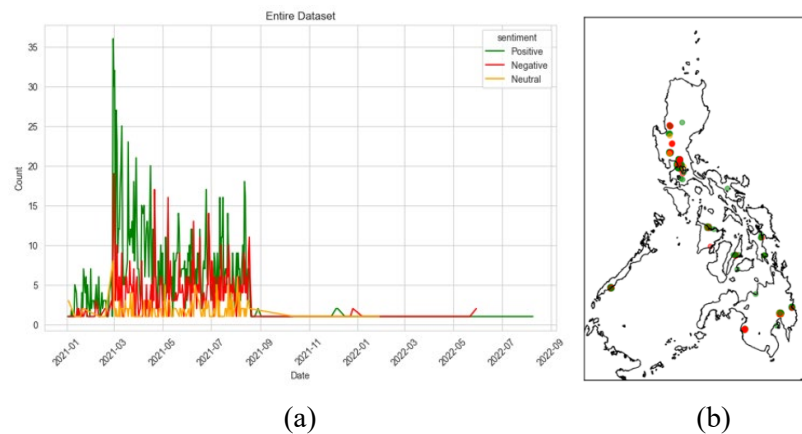


Figure 1. Trend Analysis: (1a) is Sentiment-Time Graph of Entire Operational Data and (1b) Sentiment-Geo Map of Operational Data

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Biography

Alex A. Diola was born in Manila, Philippines in 1999. He received the BS in Computer Science degree from the University of the Philippines Cebu, in 2023.

Robert R. Roxas was born in the Cebu City, Philippines in 1968. He received the BS in Computer Science degree from the Southwestern University, in 1993, and the MS in Computer Science and Ph.D. in Computer Science & Engineering degrees from the University of the Philippines Los Baños and The University of Aizu in 1999 and 2004, respectively.

SESSION 8

AI for Medical Analysis

Chair: T. Velmurugan (Dwaraka Doss
Goverdhan Doss Vaishnav College)

Classification of Tuberculosis in Chest X-rays using SMOTE-enhanced Neural Networks (SMONN)

Dr. SriPradha.G¹⁾, Dr.J.Vanathi²⁾, and Dr.T.Velmurugan^{3)}*

^{1,2)}Guru Nanak College(Autonomous), India.

³⁾PG and Computer Science D. G. Vaishnav College, University of Madras, India.

E-mail: sripradha.g@gurunanakcollege.edu.in / bscitshift2.hod@gurunanakcollege.edu.in / velmurugan_dgvc@yahoo.co.in

Abstract: Tuberculosis (TB) remains a global health challenge, and early detection is crucial for effective management and control. This study, proposed a robust approach for the automated classification of TB in chest X-rays leveraging state-of-the-art deep learning techniques, specifically neural networks. Recognizing the imbalances inherent in medical datasets, this work employs Synthetic Minority Over-sampling Technique (SMOTE) to enhance the training data, ensuring a more representative and balanced learning experience. This model is trained on a diverse dataset of chest X-ray images, with a focus on addressing the inherent class imbalances in TB detection. The neural network architecture is designed to capture intricate patterns indicative of TB manifestations in X-ray images. Through an iterative training process, the model learns to discern subtle features associated with TB, achieving remarkable accuracy. The experimental results demonstrate the effectiveness of our proposed methodology. Notably, this approach exhibits a high degree of accuracy even in the presence of imbalanced classes, showcasing the significance of the SMOTE technique in enhancing model performance SMONN. This study contributes to the ongoing efforts in leveraging advanced machine learning techniques for early disease detection, particularly in resource-constrained environments. The proposed model shows promise as a valuable tool in the hands of healthcare professionals, aiding in the timely and accurate diagnosis of tuberculosis through the analysis of chest X-ray images. As this research moves forward, the integration of such intelligent systems into clinical workflows could potentially enhance the efficiency of TB screening programs, ultimately leading to improved patient outcomes and a more effective public health response.

Keywords: Tuberculosis (TB), Deep Learning, Neural Network, Smote.

Total Number of Samples: Our dataset encompasses a total of 4200 samples, divided into the "Normal" and "Tuberculosis" classes.

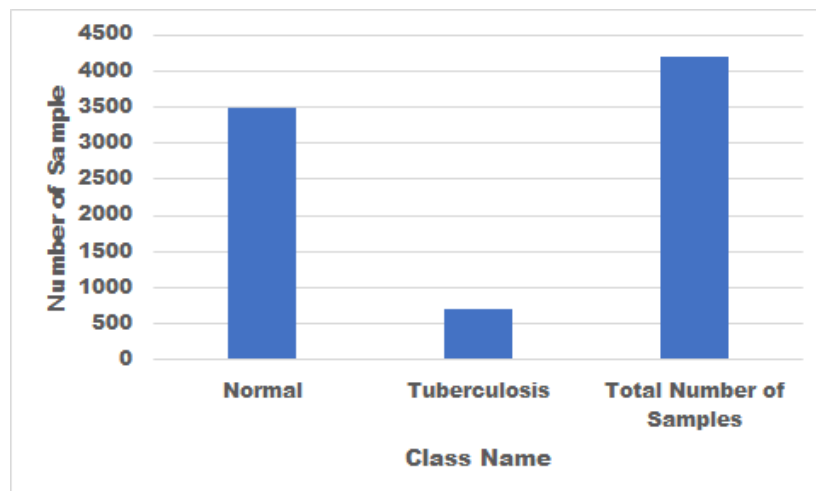


Figure 1. Details of Dataset

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Biography

Dr G. SriPradha MCA, M.Phil. Ph.D. is a highly committed Research Scholar with 12 years of teaching experience in various colleges in India. Working as Asst. Professor in Guru Nanak College, Chennai, India. She has done numerous Certification Programs in various MOOC. Mrs. SriPradha has also published papers in various International journals and has presented her research articles in many National and International Conferences. Her areas of interest include Python Programming, Java Programming. Android Programming, Computer Networks and Computer Architecture.

Dr. J. Vanathi, is a quality-oriented professional with a rich 25 years of Teaching experience. She has held various position in Arts & Science as well as in Engineering colleges. She has been awarded Ph.D. in the field of Computer Applications. Dr. J. Vanathi is now working as the HOD, Dept of Information Technology at the Guru Nanak College, Chennai. Her areas of interest include Cloud Computing, Database Management systems, Web Technology, Python Programming and Java Programming.

Dr. T. Velmurugan, is working as an Associate Professor in the PG and Research Department of Computer Science and Applications, Dwaraka Doss Goverdhan Doss Vaishnav College, Chennai-600106, India. He holds a Ph.D. degree in Computer Science from the University of Madras. He has 30 years of teaching experience. He guided more than 300 M.Phil., Research Scholars. Also, he guided 23 Ph.D. scholars and currently guiding 6 Ph.D. scholars. He has published more than 175 articles in SCOPUS and SCI indexed journals. He elected and served as a Senate Member from Academic Council, University of Madras. He has a lot of administrative experiences. He served as advisory board member to many academic institutions in and around Tamil Nadu, India.

Making use of Image Processing along with Machine Learning techniques, examination of leaf composition, and disease detection

M.Robinson Joel¹⁾, T.D.Jeba Freeda²⁾, and Prince Immanuel J³⁾

^{1,3)}Department of Information Technology, Kings Engineering College, Chennai, India.

²⁾Department of Computer Science, Noorul Islam College of arts and Science, India.

E-mail: jeba.freeda1984@gmail.com / joelnazareth@gmail.com

Abstract: Convolutional Neural Networks (CNNs) are a popular and useful deep learning application in agriculture for the identification of plant diseases. Given that CNNs excel at image-based tasks, they may be used effectively to recognise plant illnesses from photographs involving their leaves or additional pertinent elements. Take pictures of both healthy and diseased plants to create a dataset of photographs. By photographing the plants in your area, you may develop your own databases or locate publically accessible ones. To maintain consistency, resize all photos to the same dimension (for example, 224x224 pixels). Create validation, training, and evaluation sets from the dataset (for example, a 70-15-15 split). Normalise the picture pixel values to lie anywhere from zero to one. Create the architecture for CNN. Models that have been trained like VGG16, ResNet, or Inception are frequently used as a starting point and then fine-tuned for your particular application. If you have a big enough dataset, you may even create your own CNN architecture. In this study, the PlantVillage dataset was utilised. Using offline supplementation from the initial set of data, this information set has been reconstructed. This collection includes thirty-three distinct classes and around 76,000,000 RGB photos of both healthy and sick crop leaves.

Keywords: CNN, VGG16, ResNet, github, deep learning

Performance Analysis of k-Means and Fuzzy C-Means (FCM) Clustering Algorithms for Diabetic Dataset

K. Emayavaramban¹⁾ and T. Velmurugan²⁾

¹⁾Loganatha Narayanaswamy Arts College (Autonomous), ponneri, India.

²⁾PG and Research Department of Computer Science, D.G. Vaishnav College, Chennai, India.

E-mail: velmurugan_dgvc@yahoo.co.in

Abstract: In the contemporary era, with its incidence rising at an alarming rate, diabetes has become a major global health concern. This work presents a data mining approach that compares the K-Means and Fuzzy C-Means (FCM) clustering algorithms to answer the increasing demand for accurate diabetes management and prediction in a wide range of datasets. As data mining is essential for drawing insightful conclusions from large, complicated datasets, the study concentrates on using this method to improve the precision and effectiveness of diabetes prediction models. The diabetes dataset is divided into separate clusters using FCM and K-Means after preprocessing steps to manage missing values and outliers. Algorithms often define the clustering process's conclusion and the effectiveness of its domain application. Two significant clustering algorithms centroid-based K-Means and representative object-based FCM (Fuzzy C-Means) clustering algorithms are compared in this research study. These techniques are used, and the effectiveness of the output clustering is used to assess performance. The evaluation metrics accuracy, sensitivity, specificity, and AUC-ROC highlight the model's superior performance over individual clustering techniques. This study addresses the urgent problem of diabetes currently, which advances the field of diabetes prediction and highlights the crucial role data mining plays in healthcare analytics over early detection and intervention.

Keywords: Data mining; diabetic; clustering; k-means; fuzzy c-means; time complexity

A Study on Disease Detection Methods in Sugarcane Plants Using Conventional Neural Network in Deep learning

T. Angamuthu¹⁾ and A.S. Arunachalam²⁾

^{1,2)}VelsInstituteof Science, Technology and Advanced Studies, Pallavaram, Chennai, India.

E-Mail: muthu1986.its@gmail.com / arunachalam.scs@velsuniv.ac.in

Abstract: In the current times, the number of viruses and infections in the sugarcane plants is widespread. If we want to properly correct these infections, we need to use artificial intelligence such as CNN. Therefore, in this study, how to prevent the disease in sugarcane using the CNN system is taken as a test. This model is trained on a diverse dataset of automatic diagnosis images, with a focus on addressing the inherent class in detection. The neural network architecture is designed to capture intricate patterns indicative of sugarcane manifestations in automatic diagnosis images. Through an iterative training process, the model learns to discern subtle features associated with automatic diagnosis, achieving remarkable accuracy. The experimental results demonstrate the effectiveness of our proposed methodology. It discusses the various types of CNN architectures used for plants disease detection, such as AlexNet, VGGNet, ResNet, InceptionNet, and DenseNet, and their respective advantages and limitations. The survey also covers the role of CNN in plants disease detection, particularly in the area of time-series data analysis, where RNNs have proven to be effective in predicting the spread of plants diseases over time. This paper also bids a successful result for the researchers who are in the development of recognition system for sugarcane diseases.

Keywords: Convolutional neural networks, Sugarcane plants disease detection, Genetic algorithm, deep learning.

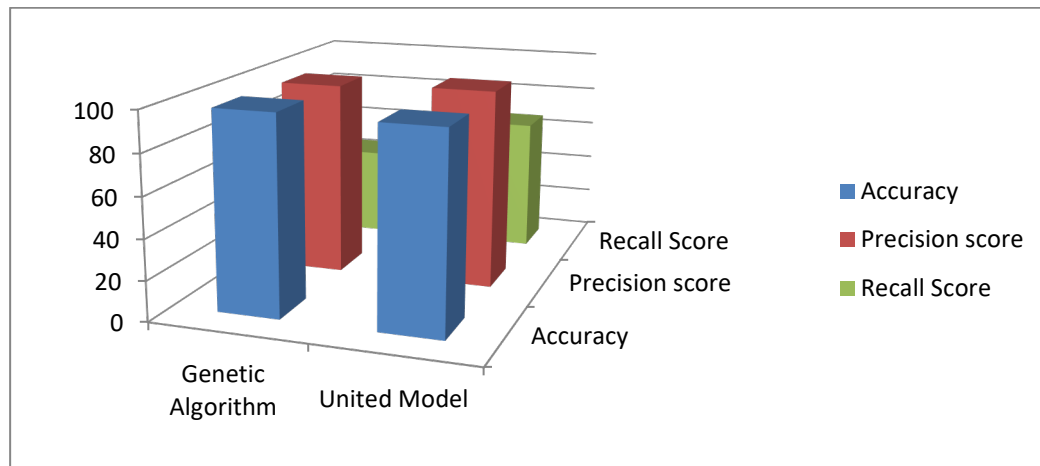


Figure 1. Comparison of the models

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Biography

Dr A.S. Arunachalam is working as an associate professor in the pg and Research Department of Computer science and Application, VelsInstituteof Science, Technology and Advanced Studies, Pallavaram, Chennai, Tamil Nadu 600117, India. His Area of Specialization includes Data mining, Artificial Intelligence, Machine Learning, Networking, Big Data analytics and Data Science.

Mr. T.Angamuthu is working as an Assistant Professor in the UG and PG In computer Science Department of Saraswathy College of Arts and Science, Olakkur, Tindivanam-604305.He has completed Master of computer application from Anna University in 2011 and completed Master of Philosophy from Thiruvalluver University in 2015.

Integrated BERT and Rule-based Framework for Comprehensive Medical Sentiment Analysis in Twitter Discourse

P.C.Sridevi¹⁾ and T.Velmurugan²⁾

^{1,2)}PG and Research Department of Computer Science, Dwaraka Doss Govardhan Doss
Vaishnav College, Arumbakkam, Chennai, India.

E-mail: sidevipc@gmail.com / velmurugan_dgvc@yahoo.co.in.

Abstract: Medical sentiment analysis plays a pivotal role in gauging public sentiments, particularly within healthcare and vaccination discussions. This work presents a significant advancement by incorporating Bidirectional Encoder Representations from Transformers (BERT) into existing rule-based sentiment analysis methodologies. Utilizing BERT, embeddings for medical text are generated to achieve a more profound and contextually aware representation of language. These embeddings are seamlessly integrated into the Sentiment Analysis for Vaccination and Health Sentiment Analysis (SAVSA) pipeline, enhancing the features derived from rule-based approaches. This integration aims to capture nuanced sentiments, context-dependent emotions, and intricate language patterns, contributing to a more comprehensive understanding of medical sentiment. The proposed approach is applied to a Twitter dataset focusing on sentiments related to COVID-19 vaccination. Performance evaluation employs standard metrics, comparing the enhanced sentiment analysis method with the existing SAVSA framework. Preliminary results indicate that the integration of BERT significantly improves the model's ability to discern the subtleties of medical sentiment, providing a more nuanced and context-aware analysis. This research contributes to the evolving landscape of sentiment analysis in the medical domain by showcasing the efficacy of combining BERT's contextual understanding with rule-based methods. The findings underscore the potential of such integrative approaches in enhancing the accuracy and depth of sentiment analysis, especially within the dynamic and complex narratives of healthcare discussions.

Keywords: BERT, Rule-based Approaches, Medical Sentiment Analysis, Twitter data.

GPT Empowered: Decoding Public Sentiment Trends on Twitter based COVID-19 Vaccination

P.C.Sridevi¹⁾, T.Velmurugan²⁾, and K. Jayabharathi³⁾

^{1,2)}PG and Research Department of Computer Science, Dwaraka Doss Govardhan Doss
Vaishnav College, Arumbakkam, Chennai, India.

³⁾ Department of Master of Computer Applications, ³⁾Guru Nanak College, Chennai, India.

E-mail: sidevipc@gmail.com / velmurugan_dgvc@yahoo.co.in / Jayabharathikannan4@gmail.com.

Abstract: Public sentiment analysis plays a critical role in understanding perceptions, especially within healthcare and vaccination contexts. This research extends the Sentiment Analysis for Vaccination and Health Sentiment Analysis (SAVSA), incorporating SentiWordNet, VADER, and SenticNet 7. An innovative enhancement leverages Generative Pre-trained Transformers (GPT) for contextual understanding. GPT generates embeddings for medical text, providing a profound contextual representation. The embeddings integrate into the SAVSA pipeline, augmenting features from VADER, SenticNet 7, and SentiWordNet, capturing nuanced sentiments and context-dependent emotions. Applied to a Twitter dataset on COVID-19 vaccination sentiments, the approach is evaluated against standard metrics and compared with SAVSA. Preliminary results indicate significant enhancement, showcasing the potential of integrating GPT for nuanced sentiment analysis in dynamic healthcare narratives. This research contributes to advancing sentiment analysis, emphasizing the effectiveness of combining rule-based methods with cutting-edge contextual models like GPT.

Keywords: SentiWordNet, VADER, SenticNet 7, GPT, Twitter Data.

SESSION 9
Machine Learning for Security
and Text analysis
Chair: Rock Hyun Choi (DGIST)

Enhancing Hill Cipher Security through Machine-Learned Key Generation

Mu. Tirumalai¹⁾ and S. Poornavel²⁾

¹⁾PG & Research Department of Mathematics, 1Pachaiappa's College, Chennai, India.

²⁾Department of Mathematics, SIMATS School of Engineering, 2Saveetha Institute of Medical and Technical Sciences, Chennai, India.

E-mail: drmt1974@gmail.com

Abstract: The Hill Cipher, a foundational symmetric key encryption algorithm rooted in matrix multiplication, is a stalwart in cryptographic domains. However, its security heavily depends on the strength of the key matrix. This research pioneers a paradigm shift by introducing an innovative method that employs deep learning, specifically integrating Long Short-Term Memory (LSTM) networks, to enhance the generation of cryptographic keys for the Hill Cipher, thereby advancing its security and efficiency. Traditional key generation often involves manual or pseudo-random matrix creation. In contrast, this study harnesses the power of deep learning algorithms, such as LSTM networks, to automate the creation of optimized key matrices. Trained on a diverse dataset comprising plaintext-ciphertext pairs, the model discerns patterns crucial for encryption strength. The training dataset covers various encryption scenarios, accommodating diverse plaintext lengths, language characteristics, and key matrix sizes. Utilizing a suite of deep learning tools, including neural networks and regression algorithms, the model identifies key matrix patterns that fortify cryptographic resilience. This novel key generation approach addresses vulnerabilities associated with poorly chosen key matrices, reinforcing resistance against known cryptographic attacks. Rigorous assessments consider encryption strength, computational efficiency, and resilience to cryptanalysis techniques. Results highlight the integration of deep learning algorithms, specifically LSTM networks, advancing classical cryptography and reinforcing encryption methods. The optimized Hill Cipher, driven by deep learning-based key generation, promises to enhance secure communication protocols.

Keywords: Hill Cipher, symmetric key encryption, deep learning, Long Short-Term Memory (LSTM) networks, cryptographic key generation

Cracking the code of Fake News: From PolitiFact Extraction to Machine Learning Mastery

Dr. M. P. Sukassini¹⁾ and Dr. R. Anandhi²⁾

^{1,2)}PG and Research Department of Computer Science,

^{1,2)}Dwaraka Doss Goverdhan Doss Vaishnav College, Arumbakkam, Chennai-600 106, India.

E-mail: sukassini.dgvc@gmail.com / sekadhi@gmail.com

Abstract: In today's internet-driven world, the rise of fake news has become a major concern. Detecting fake news involves carefully examining the content of news articles, social media posts, and other sources to figure out if the information is accurate and credible. Sentiment analysis, which looks at the emotional tone and subjective aspects of text, can be quite useful in this process. PolitiFact, a fact-checking website, plays a crucial role in evaluating the accuracy of statements made by politicians and public figures. They use a Truth-O-Meter with categories like "True," "Mostly True," "Half True," "Mostly False," "False," and "Pants on Fire" for extreme falsehoods. For this study, data were collected from the Politifact website, focusing on titles due to the lengthy nature of news content. Web scraping was employed to extract titles along with information like target values, dates, sources, and individuals. The dataset spans from March 2008 to July 2023. Dealing with raw data, several pre-processing steps were applied, including handling missing data, encoding categorical information, removing duplicates, converting titles to lowercase, eliminating unnecessary attributes, and performing text-specific tasks like tokenization, removing stop words, and stemming or lemmatization. After this thorough pre-processing, the dataset now comprises two main attributes: title and target value, with a total of 8253 rows. To train the machine, the data needed to be converted into numeric form. The Bag of Words (BoW) model, a simple yet effective way to represent text numerically, was chosen for this purpose. The dataset was then split into training and testing sets in an 80:20 ratio. Machine learning algorithms, specifically logistic regression, decision tree, and random forest, were implemented for classifying news as either factual or fake. The achieved accuracies were 71.41%, 63.75%, and 70.87%, respectively. Upon comparing these results, it was concluded that logistic regression and random forest demonstrated better performance in distinguishing between fact and fake news. In essence, this work showcases a comprehensive approach—from data extraction and pre-processing to model training and evaluation—in the quest to combat the spread of misinformation, ultimately highlighting the effectiveness of logistic regression and random forest in this endeavour.

Keywords: Fake news detection, PolitiFact, Web Scraping, Sentiment Analysis, stop words, Machine learning algorithms, Bag of Words, Stemming and Lemmatization, Tokenization.

Impact of AI Driven Conversational Chatbot: Current Advancements and Leading Innovations in Education System

G. Kanimozhi¹⁾, K. Bhuvaneswari²⁾, and T. Velmurugan³⁾

¹⁾Dept. of Information Technology, Guru Nanak College, Chennai, India.

²⁾Dept. of Computer Science, Guru Nanak College, Chennai, India.

³⁾PG and Research Dept. of MCA, D.G. Vaishnav College, Chennai, India.

E-mail: kanimozhi.may2004@gmail.com / bhukrish06@gmail.com / velmurugandgvc@yahoo.co.in

Abstract: Artificial Intelligence is becoming more and more prevalent in education. Chatbots are conversational computer programs that are intelligent and resemble human speech. They are used to provide online assistance and guidance automatically. Many professions have adopted chatbot to provide virtual support due to their improved benefits. The chatbot system is one of the most widely used AI tools for enhancing educational activities. Chatbots are being viewed as a helpful technological tool to support learning in an educational activity. Some significant problems with chatbots evolved over time as research on them developed. As a result, it is essential to assess the technology with an emphasis on key research technologies and recent developments. Chatbots are capable of addressing a broad variety of queries and activities, including scheduling appointments, providing recommendations and responding to frequently asked questions. Artificial Intelligence (AI) methods like natural language processing(NLP) and artificial neural networks are used by conversational chatbots of today to comprehend user input and provide relevant responses. This paper presents the five distinct chatbot technologies: data mining, semantic web, natural language processing, pattern matching and context aware computing. In order to help the chatbot researchers identify the current circumstance and steer it in the appropriate path, we also present the newest technological advancements.

Keywords: Artificial Intelligence, Chatbot Technology, Natural Language Processing, Virtual Assistants, Voice-Enabled Chatbots. Natural Language Generation, Pattern Recognition, Semantic Web, Data Mining, Text-Aware Computing

Text based Emotion Analysis in Social Media Data using Machine Learning techniques

B.Jayapradha¹⁾ and T.Velmurugan²⁾

^{1,2)}PG and Research Department of Computer Science,

¹⁾Dr. Ambedkar Government Arts College, Vysarpadi, Chennai, India.

²⁾Dwaraka Doss Govardhan Doss Vaishnav College, Arumbakkam, Chennai, India.

E-mail: jayapradha.bhaskar@gmail.com / velmurugan_dgvc@yahoo.co.in

Abstract: In the present digital era, a significant volume of text data that has started to emerge post-COVID with the increase in the number of people who have started using social media. The text thus generated encapsulates a hidden layer of emotion with in it. This emotion hidden in the textual data conveys a lot of understanding of the people who are responsible for the creation of the text and helps to know the person better. However, extracting the emotions from the text data is quiet a challenging task as it involves a series of pre-processing pipelines and also the application of machine learning techniques to the text involved in the research for the purpose of extracting the emotion from it. The primary objective of this research work focusses on extracting depression based emotional text using some of the machine learning techniques. It also gives a comparative analysis between the machine learning techniques in terms of accuracy. The outcomes hold potential significance for multiple stakeholders, aiding in the identification of individuals experiencing depression. This information can then facilitate appropriate counselling interventions, preventing the person under depression from escalating into suicidal thoughts or to other mental health issues.

Keywords: Data Pre-Processing, Machine Learning Techniques, Emotion Deduction, Accuracy.

Enhancing Sentiment Analysis in Electronic Product Reviews Using Machine Learning Algorithms

M. Archana¹⁾, T. Velmurugan²⁾, and U. Latha³⁾

^{1,3)}PG Department of IT & BCA, ²⁾PG & Research Department of Computer Science

^{1,2,3)}Dwaraka Doss Goverdhan Doss Vaishnav College, Chennai, India.

E-mail: archanadgvc@gmail.com / velmurugan_dgvc@yahoo.co.in / dgvcclatha@gmail.com

Abstract: In the era of electronic commerce, understanding customer sentiments through product reviews has become crucial for the smooth running of businesses. In this research work, thorough investigation of sentiment analysis in the electronic product reviews dataset, which is collected from the Flipkart and some other social media. The aim of this research work is to ascertain the polarity of consumer comments by doing sentiment analysis on text based electronic product reviews. A number of preprocessing methods were applied to the chosen dataset including stemming, tokenization, lemmatization, punctuation removal, and stop word removal. These actions were essential for improving the textual data and getting it ready for the further processing. Vectorization techniques were used to convert the text-based data into a numeric format and the converted data is given as input to the machine learning algorithms to find the sentiments. Afterwards, to guarantee a strong model evaluation, the dataset was split into two parts for training and for testing. This work analyses and categorizes sentiment by machine learning algorithms such as Naïve Bayes and Random Forest. To extract valuable sentiments from textual reviews and investigate the efficiency and performance of the above said existing machine learning methods with raw data and preprocessed data. Among these classification algorithms, the performance of the best algorithm is suggested through its obtained results.

Keywords: Naïve Bayes Algorithm, Tokenization, Stemming, Punctuation Removal, Random Forest Algorithm, Sentiment Analysis.

Ecotoxicological Impact Assessment on *Donaxincarnatus*: An In-depth Exploration of Heavy Metal Bioaccumulation Effects

S.Eswari¹⁾, R.Parthiban²⁾, and P.C.Sathyanarayanan³⁾

¹⁾²⁾ResearchScholar,³⁾Assistant professor, pachaiyappa'scollege, Chennai, India.

E-mail: pcsathyanm@gmail.com

Abstract: The marine bivalve, *Donaxincarnatus*, serves as sentniel species in environmental toxicology.Because it is rich in biological substances and has high nutritional value,it makes up the majority of fishery resources. This study delves into the ecotoxicological impact of heavy metal bioaccumulation on *Donaxincarnatus*, with a focus on its overall health, reproductive patterns, and resilience to environmental stressors. The research spans a comprehensive assessment of the bivalve's physiological response to heavy metal exposure, unraveling potential implications for its general well-being. Through meticulous observation and analysis, the study investigates alterations in the reproductive patterns of *Donaxincarnatus*, aiming to elucidate whether heavy metal bioaccumulation exerts discernible effects on the reproductive success. Furthermore, the research explores the bivalve's resilience to environmental stressors, gauging its capacity to adapt and withstand adverse conditions induced by heavy metal contamination. By adopting a purely zoological approach, devoid of computer aid, the study contributes valuable insights into the intricate interplay between *Donaxincarnatus* and its surrounding ecosystem. The findings of this ecotoxicological investigation not only enhance our understanding of the physiological responses of *Donaxincarnatus* but also hold implications for broader marine conservation efforts. The study underscores the urgency for implementing sustainable management practices to mitigate the detrimental effects of heavy metal contamination on this ecological significant species.

Keyword: Ecotoxicological , *Donaxincarnatus*, reproductive patterns, marine bivalve

Table 1. Hypothetical Spearman correlations analysis in *Donax incarnatus* exposed to Heavy Metal Bioaccumulation

	Physiological Response	Reproductive Patterns	Resilience to Stressors
Physiological Response	1	-0.832**	0.754**
Reproductive Patterns	-0.832**	1	-0.689**
Resilience to Stressors	0.754**	-0.689**	1

** Correlation is significant at the 0.01 level (2-tailed).

Acknowledgment

My heartfelt thanks go to the authors and investigators whose insightful contributions in the field have greatly influenced and informed the direction of this research.

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Biography

Dr. P.C. Sathyanarayanan serves as an Assistant Professor in the PG and Research Department of Zoology at Pachayapas's College for Men, located in Chennai – 30. Holding a PhD in Zoology from Pachayapas College, he actively guided 5 M.Phil and 2 Ph.D research scholars. Currently guiding three Ph.D scholars His academic journey includes completing his post-graduation at Pachayapas College and pursuing a B.Sc. in Zoology at Madras Christian College. With extensive administrative expertise, he has contributed significantly to the field of aquaculture and has published papers in various journals.

S. Eswari is currently pursuing her research as a scholar at Pachayapas College. She obtained her post-graduation degree from the same institution and holds a B.Sc. in Zoology from Meenakshi College for Women.

R. Parthiban From 2015 to 2019, he served as an Assistant Professor at Alwin and Madha Education College. His research focuses on the seasonal changes that modulate the nutritional content, antioxidant status, and other biochemical components in marine bivalve mollusks, specifically *Donax Incarnatus*. With a primary emphasis on Fisheries and Aquaculture, he also has a significant research interest in animal physiology. R. Parthiban has contributed to the academic field with three publications in SCOPUS journals. Furthermore, he actively participates in national and international conferences, seminars, and webinars. His outstanding contributions have been recognized with an award for the best postal presentation.

SESSION 10
Advanced Monitoring and Analysis
Techniques for Power
and communication system
Chair: Eugin Hyun (DGIST)

Comparative Analysis of Fault Detection Algorithms for MVDC Distribution Systems

Nam-Gi Park¹⁾, Jae-In Lee²⁾, Minh-Chau Dinh²⁾, Seok-Ju Lee²⁾, and Minwon Park^{1,)}*

¹⁾Dept. of Electrical Engineering, Changwon National University, Korea.

²⁾Institute of Mechatronics, Changwon National University, Korea.

E-mail: capta.paper@gmail.com

Abstract: With the continuous increase in power demand and the connection of renewable energy sources in the distribution system, the need for medium-voltage direct current (MVDC) systems with improved transfer capacity and flexibility has increased. However, DC systems require a fast and efficient fault detection strategy due to a very high and fast-rising rate of fault current. Research on fast and efficient fault detection schemes to protect DC systems has already been actively studied, but a comparative analysis of performance by applying these fault detection schemes to the MVDC distribution system has not been sufficiently performed. This paper deals with the design of fault detection algorithms and a comparative analysis of their performance for DC faults in MVDC distribution systems. Considering the Korean distribution system, a ± 18.7 kV MVDC distribution system that is connected with the 22.9 kV AC distribution system was modeled using PSCAD/EMTDC. For the protection of the MVDC distribution system, five protection schemes were selected among non-unit protection schemes, and fault detection algorithms including threshold value sets were designed. The fault detection algorithms were implemented using PSCAD/EMTDC, and their performances were comparatively analyzed for DC faults in the MVDC distribution system. As a result, among the fault detection algorithms of non-unit protection schemes, the current deviation protection schemes showed the best performance. These results can be used as a basic study for designing the protection system of the MVDC distribution system.

Keywords: MVDC; fault detection; non-unit protection schemes

Acknowledgment

This work was supported by the Korea Institute of Energy Technology Evaluation and Planning(KETEP) grant funded by the Korea government(MOTIE) (20225500000060)

Biography

Minwon Park received the B.S. degree in electrical engineering from Changwon National University, Changwon, South Korea, in 1997, and the M.S. and Ph.D. degrees in electrical engineering from Osaka University, Osaka, Japan, in 2000 and 2002, respectively.

Nam-Gi Park received the B.S. degree in electrical engineering from Changwon National University, Changwon, South Korea, in 2022.

Design of a RUL Prediction Algorithm for a 2 MW class Wind Turbine Blade and Tower

Thi-Tinh Le¹⁾, Minh-Chau Dinh²⁾, Changhyun Kim²⁾, Seok-Ju Lee²⁾, and Minwon Park^{1,)}*

¹⁾ Dept. of Electrical Engineering, Changwon National University, Korea.

²⁾ Institute of Mechatronics, Changwon National University, Korea.

E-mail: capta.paper@gmail.com

Abstract: In the past few years, wind energy has experienced significant growth in its installed capacity. Just like any other power generation equipment, wind turbines represent a substantial investment. Wind farms invest in turbine generators with the anticipation of achieving long-term profits by selling electricity to businesses and distributors. However, wind turbine failures can have detrimental effects on a wind farm's profitability, resulting in downtime and expensive repairs. To mitigate the risk of downtime and equipment failures, regular turbine maintenance plays a crucial role in early problem detection and correction. Implementing operations and maintenance (O&M) systems can enhance profitability, ensure uninterrupted operation, optimize performance, extend equipment life, and enhance reliability [1]. Condition monitoring and remaining useful life (RUL) prediction is important functions in O&M technology. In the design of wind turbines, the Palmgren-Miner rule (Miner) is commonly employed to ensure that the cumulative damage over the intended lifetime remains below a safety threshold [2]. However, since the Miner damage variable cannot be directly measured, a substitute known as the damage equivalent load (DEL) is used. DEL represents the load level at a specific number of cycles that results in the same damage as the combined effect of multiple load cycles with varying amplitudes. Utilizing DEL enables obtaining a measurable quantity from an operating turbine, which can be compared with simulation results obtained during the design phase. In contrast, Miner's damage is an abstract quantity representing the ratio of the number of cycles and is challenging to quantify. Consequently, when verifying fatigue life in wind farms, DELs are typically used instead of Miner's damage. In this paper, we developed a RUL prediction algorithm for blade, and tower of wind turbine based on their damage equivalent load values. To accomplish this, historical time series data of the wind turbine's operational conditions were collected, including load cycles and mean wind speeds. The Rainflow counting algorithm was employed to identify and count loading cycles accurately. The S-N curve for the material of the turbine components was determined, providing insights into the material's fatigue behaviour. Using the S-N curve exponent and the Rainflow-derived load cycles, the DEL values were calculated for both the blades and tower. These DEL values served as indicators of the accumulated fatigue damage in the components [3]. A predefined threshold was utilized to assess the health status of the blades and tower. When the DEL exceeded the threshold, it indicated that the components were approaching their failure limit. Furthermore, the computed DEL values were used to estimate the RUL of blades and tower. By comparing the actual accumulated fatigue damage with the predicted fatigue life based on the material properties, an estimation of how much operational life remained for the components was obtained. By accurately predicting the fatigue life of the blade and tower, maintenance activities can be scheduled at appropriate intervals, ensuring that components are inspected and repaired before critical failure points are reached. This precautionary approach minimizes the risk of sudden blade failures and associated costs, such as production losses and emergency repairs. A proactive maintenance strategy, driven by predictive fatigue life, contributes to the reliability and overall lifespan of wind turbines. By promptly addressing potential problems, turbines can have their operating life extended, optimize their performance, and increase the return on investment for wind energy projects.

Keywords: Condition Monitoring; Damage Equivalent Load; Operations and Maintenance; Remaining Useful Life; Wind turbine.

Acknowledgment

This work was supported by the Korea Institute of Energy Technology Evaluation and Planning(KETEP) grant funded by the Korea government(MOTIE) (20223030020180, Development of durability evaluation and remaining life prediction technology for wind turbine life extension).

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Thi Tinh Le received the B.S. degree in electrical engineering from the Hanoi University of Science and Technology, Hanoi, Vietnam in 2021.

Analysis of Antenna Characteristics Depending on Angle Between Flat Radar Cover and Radar Antenna

Junho Yeo^{1)*}, Jeong Tak Ryu²⁾, and Seungeon Song³⁾, and Jonghun Lee³⁾

¹⁾ School of Artificial Intelligence, Daegu University, Korea.

²⁾ Department of Electronics Engineering, Daegu university, Korea.

³⁾ Division of Automotive Technology, Research Institute, DGIST, Korea.

E-mail: jyeo@daegu.ac.kr

Abstract: In this paper, the analysis of the antenna characteristics depending on the angle between a flat radar cover and a radar antenna is studied. The thickness of the flat radar cover was 10 mm and polycarbonate dielectric material with a relative dielectric constant of 2.9 was used. A 4×1 microstrip patch array antenna was designed to operate the 24.0 to 24.25 GHz frequency band on an HF-350F substrate, as a reference antenna. The effects of varying the angle between the flat radar cover and the radar antenna on the antenna performances, such as input reflection coefficient, radiation patterns, and gain are investigated through simulation. It was found that the radar cover acted as a prism depending on the angle, so the main beam angle changed and maximum gain varied accordingly.

Keywords: radome; flat radar cover, antenna, angle, main beam direction, radio detection and ranging (RADAR)

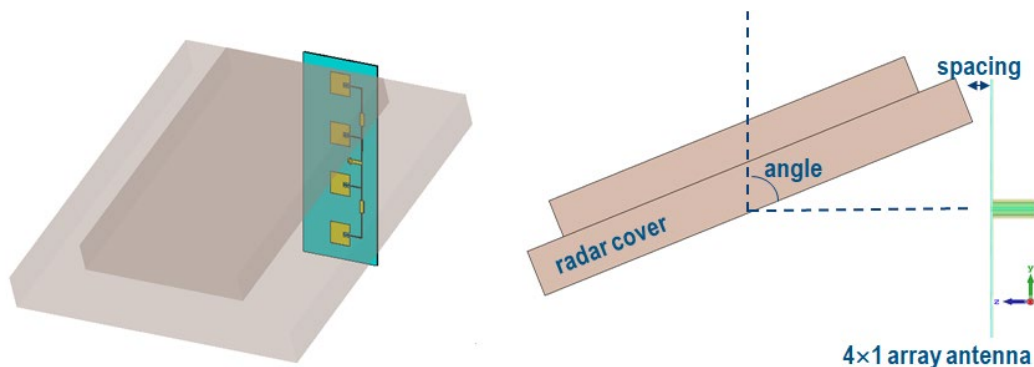


Figure 1. Effect of varying the angle between the flat radar cover and 4×1 array antenna

A radar sensor or system operating in a harsh outdoor environment requires a radome for protection. The radome protects radar systems or antennas from environmental influences such as rain, snow, wind, dust, and temperature, as well as mechanical influences. Typically, the radome is placed parallel to the radar antenna at a distance of about half the free space wavelength. However, in special cases, the radome may need to be placed at an angle rather than parallel to the antenna. The effect of varying the angle between the flat radar cover and radar antenna was investigated using a 4×1 microstrip patch array antenna as a reference antenna. The input reflection coefficient, radiation patterns, main beam angles, and gain of the 4×1 array antenna were compared. For the radar cover dielectric material, polycarbonate whose relative permittivity and loss tangent at 24 GHz are 2.9 and 0.01, respectively, was used.

The radar cover combines a front part with a length of 53.6 mm, a width of 45.6 mm, and a thickness of 5.5 mm, and a rear part with a length of 44.6 mm, a width of 25.6 mm, and a thickness of 4.5 mm, and the overall thickness is 10 mm. A 4×1 microstrip patch array antenna was designed to operate the 24.0 to 24.25 GHz frequency band. The frequency bandwidth for a voltage standing wave ratio less than 2 of the input reflection coefficient was 23.836 – 24.402 GHz (2.35%). Realized gain at z-axis direction ranged from 10.94 dBi to 11.11 dBi in the 24.0 to 24.25 GHz band with maximum gain at 24.125 GHz. When the angle of the radar cover is 0, the spacing between the radar cover and the 4×1 array antenna is 27 mm, which is slightly larger than half the length of the front part.

When the angle of the radar cover is less than 20 degrees, the main beam direction is in the +z-axis direction, but from 30 degrees or more, the main beam direction gradually moves upward.

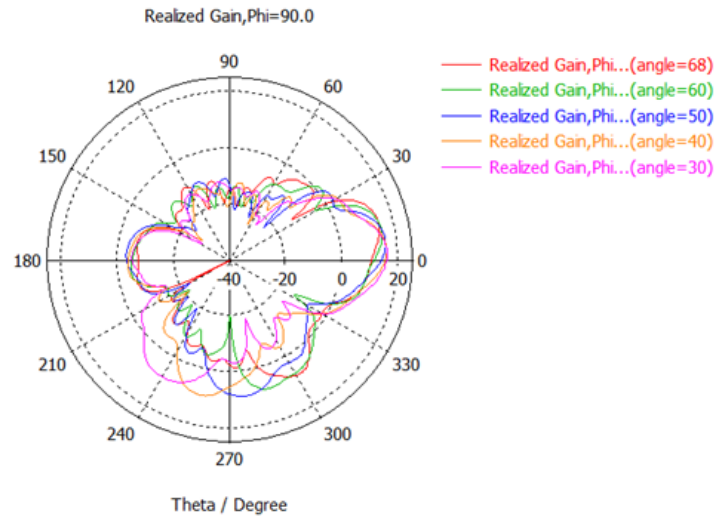


Figure 2. Radiation patterns on the y-z plane at 24.125 GHz when the angle varies from 30 degrees to 68 degrees

Acknowledgment

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Virtuliving: Your Dream Residence In VR

Suryawanshi Ansh¹⁾, Vathore Dhammdeep²⁾, Choudhary Prabhat³⁾, C.Kalpna⁴⁾, and Swati Pillai⁵⁾

^{1,2,3)} Student Department of Science(Information Technology), SST College of Arts and Commerce .Ulhasnagar . Maharashtra, India.

^{4,5)} Department of Science(Information Technology), SST College of Arts and Commerce .Ulhasnagar . Maharashtra, India.

E-mail: ansh.it22034@sstcollege.edu.in / dhammdeep.it22077@sstcollege.edu.in / prabhat.it22011@sstcollege.edu.in / ckalpna@sstcollege.edu.in / swatipillai@sstcollege.edu.in.

Abstract: This Research Work delves into the integration of virtual reality (VR) technology in home design, presenting a novel approach to creating a more immersive and personalized experience for customers. Leveraging VR technology, users can navigate seamlessly through different spaces, providing them with a tangible sense of a prospective home environment. By importing household designs and utilizing real 3D models, coupled with the incorporation of the Virtual Reality Modeling Language (VRML) and interactive linking of prototypes, a web 3D virtual reality display system is rapidly established to showcase furniture designs. The system employs a diverse range of interactive methods, facilitating the adjustment and comparison of designs, thereby enhancing clients' awareness of the actual outcomes of home decoration and ultimately elevating customer satisfaction. Furthermore, the system's versatility extends to virtual simulation practices in scheme design. Empirical evidence from engineering practice attests to the simplicity and high efficiency of system development, demonstrating its capacity to significantly expedite household decoration engineering design schedules, reduce time costs, and prove invaluable in engineering applications. This article introduces a fresh perspective on the application of virtual reality technology in home design, emphasizing its practical benefits and efficiency in the engineering domain.

Keywords: Virtual Reality Technology, Home Design Realistic Experience, 3D Model, Virtual Reality Modeling Language (VRML).

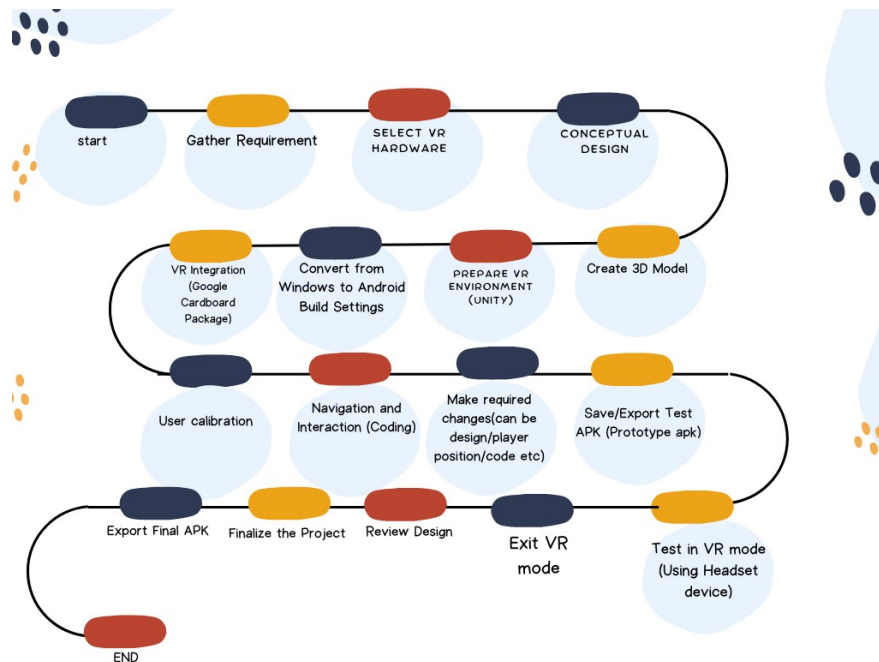


Figure 1. Framework of 3D Model

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Smart learn times: API-Powered Education Headlines APP

Chaudhari Mayur¹⁾, Jangale Kunal²⁾, C. Kalpana³⁾, Khushbu Purswani⁴⁾, and J.C.Purswani⁵⁾

^{1,2,3,4,5)} **Department of Science(Information Technology), SST College of Arts and Commerce .Ulhasnagar . Maharashtra, India.**

E-mail: mayur.it22028@sstcollege.edu.in / kunal.it22081@sstcollege.edu.in / ckalpana@sstcollege.edu.in / khushbup@sstcollege.edu.in / principal@sstcollege.edu.in

Abstract: The News Update API Research work is a comprehensive initiative designed to create a robust and scalable Application Programming Interface (API) for real-time news updates. In an era where information is continually evolving, the project aims to offer developers, businesses, and media organizations a standardized and seamless way to integrate the latest news content into their applications and platforms. It aspires to serve as a valuable resource for developers building applications ranging from news aggregator platforms to personalized news feeds within mobile apps. By fostering innovation and accessibility in the realm of real-time news delivery, the project endeavours to contribute to the evolving landscape of information dissemination in the digital age. The goal is to simplify the complexities associated with accessing and incorporating real-time news updates into diverse software applications. The News Update API Project stands as a catalyst for progress, fostering an environment of creativity and accessibility within the domain of real-time news delivery. The study emphasizes collaboration and forward-thinking development practices to be a significant contributor to the evolving landscape of information dissemination. It aspires to play a pivotal role in shaping the future of how news is accessed, shared, and experienced in our interconnected digital world. Through this initiative, the project seeks to set new standards for excellence and adaptability in the realm of real-time news updates.

Keywords : Scalability, Performance Optimization, Authentication, Security, Documentation, Support System, Monetization Models, Information Dissemination, Application Programming Interface, News Content, Developer Resources, Innovation, Accessibility.



Figure 1. Framework of New Application

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SESSION 11
Advanced Applications of Machine Learning
and Numerical Methods
Chair: Junho Yeo (Daegu Univ.)

Design of an Object Detection Model for an Automatic Ship Unloader System

Chi-Hieu Ngo¹⁾, Chang-hyun Kim²⁾, Minh-Chau Dinh²⁾, Seok-Ju Lee²⁾, and Minwon Park^{1,)}*

¹⁾Dept. of Electric Engineering, Changwon National University, Korea.

²⁾Institute of Mechatronics, Changwon National University, Korea.

E-mail: capta.paper@gmail.com

Abstract: In recent years, automation is rapidly emerging as a dominant global trend, revolutionizing various industries worldwide. In response to escalating labor costs and the quest for greater efficiency, many companies are harnessing innovative technologies to automate their processes. From the application of robotics in manufacturing to the use of AI in customer service, automation is transforming business operations, heightening productivity, accuracy, and dependability. Similarly, automation is becoming increasingly prevalent in seaports worldwide, reflecting a significant shift in maritime logistics. Seaports are pivotal locations for receiving, unloading, and transshipping goods and materials. They manage a wide range of goods, from raw materials and commodities to finished products, making them integral to global supply chains. Seaports contribute significantly to the economic growth and development of a nation by attracting trade, generating employment, and promoting industrial activity. Statistics reveal that approximately 80% of the global merchandise trade volume is conducted through sea transportation [1]. Therefore, investing in the development and modernization of seaports is of paramount importance for countries striving to enhance their international trade competitiveness. Amidst the evolving landscape of global commerce and increasing demands for speed and efficiency, seaports are constantly innovating and adopting new technologies to streamline operations and increase their capacity. Advancements in technology and the onset of Industry 4.0, especially the application of artificial intelligence technologies to machine systems, have brought about intelligent and cost-effective solutions. Notably, using Industry 4.0 technology to develop automatic unloading machine systems like Grap Type Ship Unloader (GTSU) for goods and materials is considered an optimal way to enhance seaport efficiency. A crucial aspect of developing this automated system is the task of enabling the system to recognize the location of material storage for loading and unloading. The key to this solution lies in image-processing technologies. With the rapid progress in computer vision, deep learning models, and image sensors in recent years, the task of recognizing material storage locations for GTSU systems can be performed with high accuracy. This paper proposes AI models designed to detect cargo holds and extract working points, utilizing both the LiDAR sensor and the camera in the GTSU system. The model for cargo hold detection is developed using image data of the cargo hold, employing the You Only Look Once (YOLO) model. Concurrently, the model responsible for extracting the coordinates of working points for the GTSU system is designed by integrating the cargo hold detection and point cloud processing models. After testing the AI models for the lab-scale GTSU model, the results show that the cargo hold detection achieves an accuracy of approximately 96%. Additionally, the working point coordinates extracted from the sensor system show a deviation of 5-10% compared to traditional measurements. The results of this study will be applied to develop a fully automatic GTSU system.

Keywords: Automation System; Smart Port; Computer Vision; Artificial Intelligence algorithm; You Only Look Once (YOLO) method

Acknowledgment

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Biography

Minwon Park received the B.S. degree in electrical engineering from Changwon National University, Changwon, South Korea, in 1997, and the M.S. and Ph.D. degrees in electrical engineering from Osaka University, Osaka, Japan, in 2000 and 2002, respectively.

Chi Hieu Ngo received the B.S. degree in energy department from the University of Science and Technology of Hanoi, Hanoi, Vietnam, in 2020.

Data Augmentation for Finger Gesture Recognition using Label Spreading Method

Woosoon Jung¹⁾, Jeong Tak Ryu²⁾, Kyuman Jeong³⁾, and Yoosoo Oh^{4,*)}

¹⁾Research Institute for Special Education & Rehabilitation Science, Daegu University, Korea.

²⁾Dept. of Electronic and Electrical Engineering, Daegu University, Korea.

^{3, 4)}School of AI, Daegu University, Daegu University, Korea.

E-mail: yoosoo.oh@daegu.ac.kr

Abstract: Lack of training data is an important factor in determining AI performance. In this study, we propose a data augmentation method to overcome the training data shortage environment. In this study, we used the Label Spreading method which is one of the semi-supervised learning. As a result, we achieved performance improvement with the generated dataset which has 39 times more samples than the original dataset.

Keywords: Data Augmentation, Finger Gesture, HAR, Label Spreading

In supervised learning, if there are not enough data samples to learn from, it causes performance degradation. In particular, when the number of samples is insufficient or a low-quality dataset is used, reliable performance is not achieved regardless of preprocessing or Artificial Intelligence (AI) model [1-3]. To overcome this problem, this study proposes a method to augment data using the Label Spreading algorithm which is one of the semi-supervised learning methods. The target dataset is finger movement data collected by a two-axis flex sensor, which has 10 classes.

The number of samples in the original dataset is 50 per class. 25 samples are used for training. The remaining 25 samples are used for evaluation. Data augmentation proceeds through the following process. First, generate unlabeled samples with Gaussian noise added to the original data. The next process is labeling using Scikit-learn's Label Spreading model [4]. Figure 1 indicates each process.

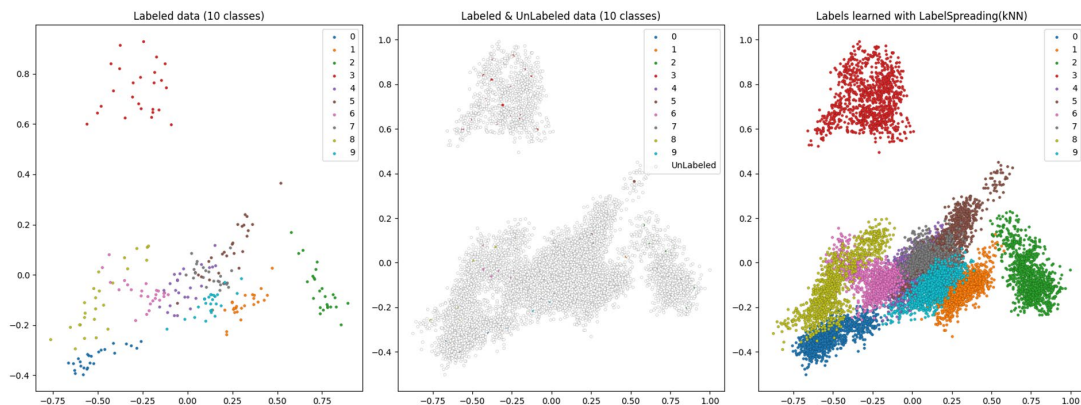


Figure 1. Unlabeled sample generation and Label Spreading process

While keeping the 250 samples corresponding to the existing testset, we generated 9,750 data samples more so that a total 10,000 samples are used as a trainset. As a result of the experiment, only 4 samples with incorrect label spreading were found in the dataset. As a result of comparing the performance of the two cases with the Multi-Layer Perceptron (MLP) which has 15 nodes in the single hidden layer, the MLP trained with existing 250 samples shows an accuracy of 94.4%, and the data trained with 10,000 samples shows an accuracy of 95.2%.

Acknowledgment

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2022S1A5C2A07091326)

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Numerically solving various partial differential equations on non-flat surfaces

Yongho Choi¹⁾

¹⁾Dept. of Computer & Information Engineering, Daegu University, Korea.

E-mail: yongho_choi@daegu.ac.kr

Abstract: In this study, we introduce research on numerically solving various partial differential equations(PDEs) on non-flat surfaces. Many applications in the natural and applied sciences require the solutions of PDEs on surfaces. In biology, there are pattern formations on the animal skin [1,2] such as zebra, giraffe, shell, and insect wing. In physics, there is research on fluid flow on surfaces [3,4] such as on the Earth and bleaching on objects. It is also being studied in various fields such as chemistry [5] and medicine [6]. To solve PDEs on a non-flat surface numerically, we first explain how to reconstruct the surface when cloud point data [7] or slice data [8] is given. We set the computational domain using the narrow band domain [9] and closest point method [9]. We used the Allen-Cahn equation [9], conservative Allen-Cahn equation [10], and Lengyel Epstein equation [11] as governing equations. To solve the PDEs, we use splitting method [12]. Also, we present the phenomenological features of each equation by showing various numerical simulations and performing mathematical analysis.

Keywords: Partial differential equations, non-flat surfaces, PDEs on surface, narrow band domain, closest point method, splitting method.

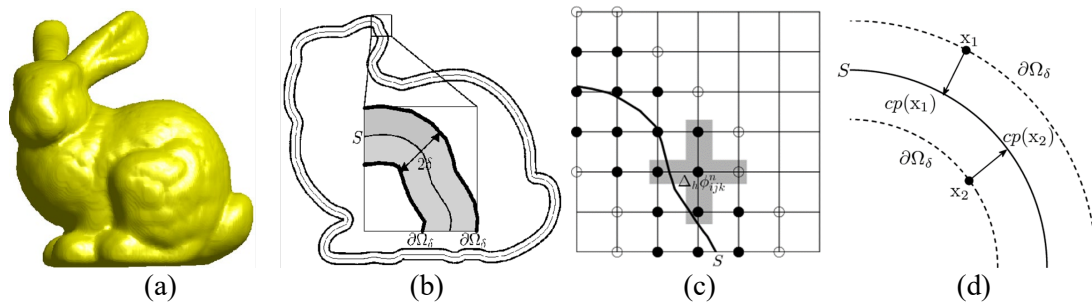


Figure 1. (a) Surface, (b) Narrow band domain, (c)-(d) Closest point method

Acknowledgment

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Biography

Yongho Choi received the B.E. degree in mathematics from the University of Kyonggi, in 2012, and the Ph.D. degrees in applied mathematics from the University of Korea in 2018.

Smart Timer Application Development using Flutter

Sung-Hyeon Jin¹⁾, Kyung-Ae Cha^{2)}, Jeong-Tak Ryu³⁾, and Kyoung-Ock Park⁴⁾*

^{1,2)}Dept. of Artificial Intelligence, Daegu University, Korea.

³⁾Dept. of Electric Engineering, Daegu University, Korea.

⁴⁾Dept. of Elementary Special Education, Daegu University, Korea.

E-mail: chaka@daegu.ac.kr

Abstract: Using cross-platform in mobile application development is very efficient. In this paper, we develop a smart timer application using Flutter, an open source SDK, to develop more stable, high-performance mobile applications for operating systems such as iOS and Android. In particular, a smart timer app that integrates voice support and a digital interface was designed to support the daily lives of people with developmental disabilities. Various apps utilizing IT technology for supporting the daily lives of people with disabilities are being developed. Mobile app development for visual and hearing impaired is actively progressing. However, there is not as much active development in apps specifically tailored for developmentally disabled. The IT support required for developmentally disabled focuses on assisting with tasks related to daily life, particularly in the area of time management. Particularly, situations arise where even mundane tasks, such as time management and scheduling for daily life, require assistance from non-specialists[1]. Accordingly, this paper implements a smart timer app designed for developmentally disabled. Fig.1 depicts the module configuration of the Smart Timer app which is implemented of the app utilized Flutter; a platform released by Google in 2017[2]. The timer can be set and operated through dragging and buttons in the visual interface, and the timer's status is intuitively represented in text for easy understanding. To enhance the convenience of timer usage for individuals with developmentally disabled or their caregivers, voice input is implemented to set and activate the timer. Furthermore, digital images, not commonly available in regular timers, are displayed in various ways to aid in improving the concentration of individuals with developmentally disabled.

Keywords: Flutter application, Smart timer app, Voice support

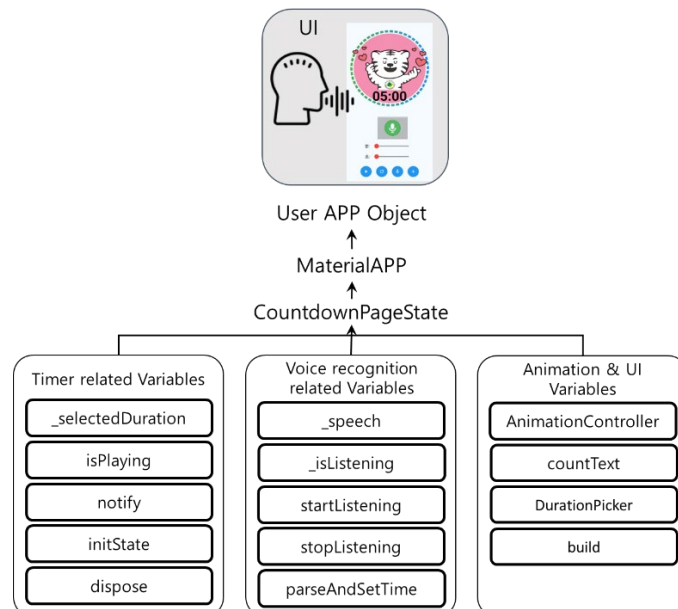


Figure 1. Module Configuration of the Smart Timer App and UI

Results: In this paper, we implemented a smart timer app with voice recognition support using the Flutter platform. The use of the Flutter platform ensures compatibility across various mobile environments. Moreover, this app can be useful to support voice order to activate such a timer facility.

Acknowledgment

This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea(NRF-2022S1A5C2A07091326)

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Biography

Kyung-Ae Cha received the Ph.D. degree in computer science from the Kyungpook National University, in 2003.

Sung-Hyeon Jin is undergraduate student at Daegu University. Jeong-Tak Ryu received the Ph.D. degree in electrical engineering from Osaka University, in 1999, and Kyoung-Ock Park received the Ph.D. degree in special education from Dankook University, in 2006.

Experimental Performance Analysis of 24 GHz RADAR with Different Radome Materials and Configurations

Junho Yeo^{1,}, Jonghwan Lee², and Jeong Tak Ryu²*

1) School of Artificial Intelligence, Daegu University, Korea.

2) Department of Electronics Engineering, Daegu university, Korea.

E-mail: jyeo@daegu.ac.kr

Abstract: In this paper, the effects of placing different radome materials with different configurations on the 24 GHz RADAR performance are experimentally investigated. Radomes made of polycarbonate and 3D printing material are used with different configurations. Photopolymer resin for a stereolithography-type 3D printer is used as a 3D printing material, and its performance as a radome is compared with the case of polycarbonate, which is a most commonly used radome material with its low dielectric loss, transparency, light weight, and resistance to rain erosion. For different configurations of the radar and radome, the spacing between the radar and radome was varied. The distance measured from the radar was used as a radar performance indicator for different radome materials and configurations. The distance was measured using a commercial 24 GHz radar when a person moves away from the radar at a constant speed in the hallway of the building and then approaches again. It was demonstrated experimentally that the maximum measured distance was longer and errors were smaller when polycarbonate was used as the radome because of the difference in dielectric loss. In addition, the best performance was achieved when the distance between the radar and radome was near half the free space wavelength.

Keywords: radome, polycarbonate, 3D printing material, resin, configuraton

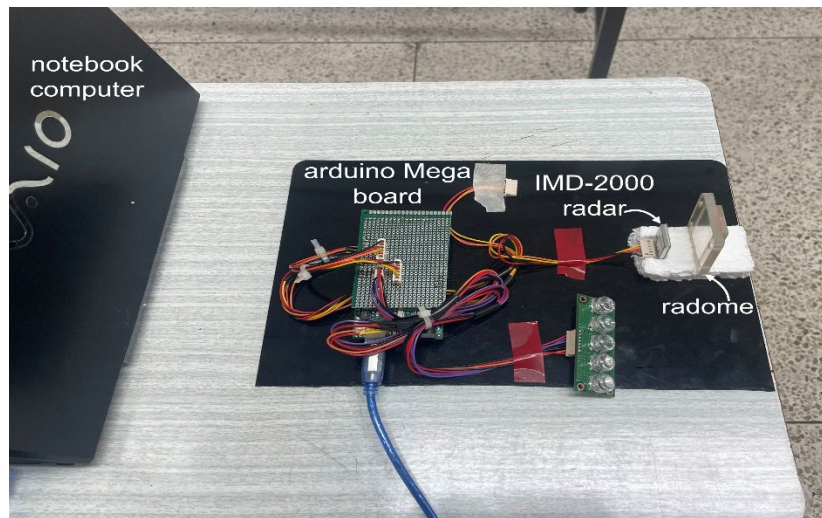


Figure 1. Experiment setup for performance comparison of 24 GHz radar with different radome materials and configurations

In general, the thickness of the radome is half the effective wavelength of the dielectric material used as the radome. However, in special cases, it may be manufactured thicker than the optimal thickness for mechanical durability and convenience of manufacturing. The effect of variations in the spacing between the thicker radome and the radar on the radar was analyzed using the distance measured from the radar as a performance indicator, when a person moves away from the radar at a certain speed in the hallway of a building and then approaches again.

Recently, research on radomes manufactured using 3D printers has been studied. However, the dielectric loss of radomes produced by 3D printers in the millimeter wave band is large, so an analysis

of its impact is necessary. For the 3D printed radome material, photopolymer resin for a stereolithography-type 3D printer was chosen. The relative permittivity and loss tangent of resin at 24 GHz are 3.142 and 0.071, respectively. Polycarbonate whose relative permittivity and loss tangent at 24 GHz are 2.9 and 0.01, respectively, was used as a reference for performance comparison.

IMD-2000 was used to measure the distance of a moving person. IMD-2000 is a radar sensor operating in the 24 GHz frequency band with a built-in signal processing function from Germany's InnoSenT GmbH. To collect distance information measured by the IMD-2000 radar, an arduino Mega board was connected using a UART interface. The measured distance information was stored in a notebook computer at an interval of 300 msec.

The distance was measured when a person moved away from the IMD-2000 radar at a constant speed by more than 50 m in the hallway of a building and then came closer again. The average speed when moving away and approaching is around 1m/sec, and the distance information measured when the separation distance between the radar and radar cover is 2 mm, 5 mm, and 20 mm was compared with when there was no radome. Five experiments were conducted for each of the four cases to calculate the sum of the absolute values of the errors between the expected and measured distances when a person moves away from the radar and when the person approaches again. The maximum measured distance, the sum of errors between the expected and measured distances, the number of errors exceeding 2 to 3 m, and the number of times that measurement was not possible were compared.

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SESSION 12
Intelligent Semiconductor
Chair: Kyung Ki Kim (Daegu Univ.)

LightDet: Lightweight Detector for Small Objects

Akshay Kumar Sharma¹⁾ and Kyung Ki Kim^{2,)}*

^{1) 2)}Dept. of Electronic Engineering, Daegu University, Korea.

E-mail: kkkim@daegu.ac.kr

Abstract: In this paper, we introduce a new lightweight object detection framework specifically designed for low-power edge devices. This framework overcomes the challenges posed by conventional, resource-demanding computer vision models. Drawing inspiration from the Single Shot Detector (SSD) approach, our developed detector features a streamlined yet effective network architecture. A key innovation is the incorporation of an 'enhancement block', which markedly improves the detection of smaller objects. The architecture of the model consists of two main elements: the Light_Block, which utilizes Depth-wise and Pointwise Convolution layers for efficient feature extraction, and the Enhancer_Block, focusing on the improved detection of diminutive objects. Our model, developed from the ground up using the Udacity Annotated Dataset with a resolution of 300x480 pixels, bypasses the requirement for pre-existing classification weights. With a size of only 5.5MB and about 0.43M parameters, our model achieved a mean average precision (mAP) of 27.7% and a processing speed of 140 FPS. These results demonstrate that it surpasses traditional models in both accuracy and speed. This work highlights the effectiveness of lightweight designs in enhancing object detection capabilities on edge devices without sacrificing precision.

Keywords: Object detection, Lightweight DNN, CNN, Image Classification

This paper introduces a novel lightweight object detection model for low-power edge devices, optimizing resource utilization. It innovates upon traditional models by integrating a base network influenced by the Single Shot Detector (SSD) framework, focusing on efficient feature extraction and enhanced detection of smaller objects. The model combines a Base Network and SSD7 detection head, introducing Light_Block and Enhancer_Block. The Light_Block, using Pointwise and Depthwise Convolution layers, reduces computational load, while the Enhancer_Block, shown in Fig. 1, improves small object detection accuracy. This is achieved by deploying pointwise convolutions at various scales to highlight critical features [1][2].

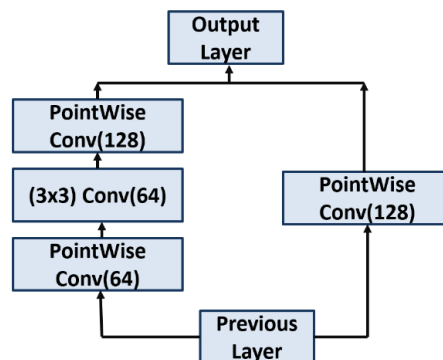


Figure 1. A sample line graph

The base network processes 300x480 input images, first using a (5x5) convolution layer, followed by six Light_Block layers for feature extraction, and finally, the Enhancer_Block to refine detection of smaller objects. The output sizes from Light_Block layers, crucial for Enhancer_Block's processing, are (37x60), (18x30), (9x15), and (4x7). The model, trained on the Udacity Annotated Dataset without pre-trained weights, emphasizes efficient training and deployment.

The model, occupying only 5.5MB and comprising around 0.43M parameters, demonstrates enhanced performance with a mean average precision (mAP) of 27.7% and speed of 140 FPS, outperforming

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conventional models as shown in Table I. Fig. 2 illustrates the model's superior ability to detect distant objects compared to existing models.

Table 1. MAP & FPS comparison with conventional models

Model	MAP	FPS
SSD7 [3]	22.9%	~180
FPN SSD7 [4]	26.9%	~30.070
Proposed	27.7%	~140

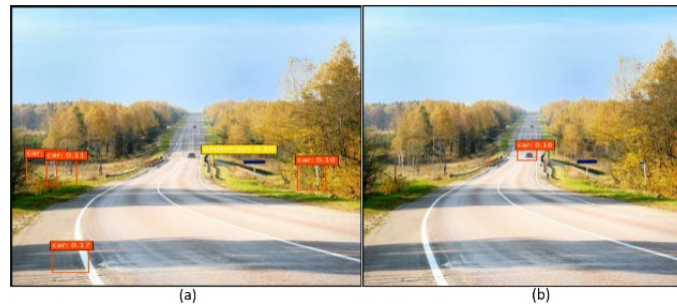


Figure 2. Detection result comparison with conventional model

The proposed model, efficient in terms of size and computational requirements, successfully detects small and distant objects. Trained from scratch on the Udacity dataset, it showcases a significant improvement over conventional models, both in precision (27.7% mAP) and efficiency, marking a step forward in object detection for low-powered devices.

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Nonlinear Analysis of Neuronal Activity with Two Firing Patterns

Yoko Uwate¹⁾ and Yoshifumi Nishio¹⁾

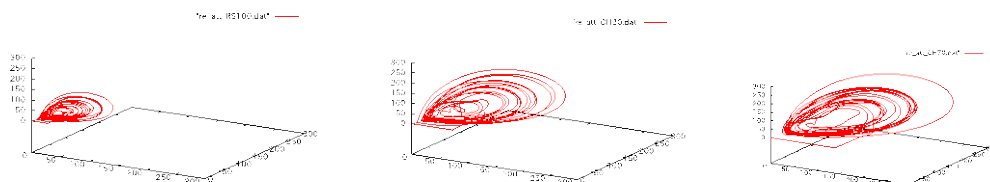
¹⁾Dept. of Electrical and Electronics Engineering, Tokushima University, Japan.

E-mail: uwate@ee.tokushima-u.ac.jp / nishio@ee.tokushima-u.ac.jp

Abstract: Understanding how brain circuits develop and operate is a major goal for many neuroscience projects. Burst patterns in neuronal networks may have an important role in information processing in the brain. Therefore, detecting and analyzing burst patterns are investigated in various fields. Although it is important to study burst patterns in order to understand the correlation and communication processes of neurons, unveiling a structure of the whole neuronal network is also required. On the other hands, nonlinear time-series analysis is a useful tool for characterizing the dynamics behind the observed time-series data. The neuronal data obtained from living neurons should be high-dimensional and dynamic nature. In such case, nonlinear time-series analysis can be used to characterize the neuronal data. Previously, we proposed the method of feature extraction of neuronal activity using nonlinear time series analysis [1]. We also investigated attractor reconstructions obtained from time series data of spike rate [2]. By using the simulations, we confirmed that the attractor of the network with high connectivity is larger size than the network with low connectivity. However, the complexity of attractor of network with low connectivity is higher than the network with high connectivity. In such simulations, only one firing pattern is used. In the real brain networks, there are several types of firing patterns.

In this study, we investigate feature of neuron group composed of two different firing patterns produced by Izhikevich neuron model using nonlinear analysis. We confirm that the neuronal activity with high ratio of chattering has high spike rate in the whole network. Figure 1 shows the simulation results when neuronal time-series data is embedded in 3-dimensional space with time delay 10. From these figures, we confirm that the size of attractor of chattering neuron 70% is largest than the others. However, no information other than the size of the attractor can be understood from these results.

Keywords: Neuronal activity, Nonlinear analysis



(a) Chattering neurons: 10%. (b) Chattering neurons: 30%. (c) Chattering neurons: 70%.

Figure 1. Attractor reconstruction.

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Biography

Yoshifumi Nishio received the B.E., M.E., and Ph.D. degrees in Electrical Engineering from Keio University, Yokohama, Japan, in 1988, 1990, and 1993, respectively. In 1993, he joined the Department of Electrical and Electronic Engineering at Tokushima University, Tokushima, Japan, where he is currently a Professor. From May 2000 he spent a year in the Laboratory of Nonlinear Systems (LANOS) at the Swiss Federal Institute of Technology Lausanne (EPFL) as a Visiting Professor. He has been an adjunct professor of Xi'an Jiaotong University from 2012 and of the University of Electronic Science and Technology of China (UESTC) from 2019. His research interests are in the areas of nonlinear circuits engineering, including the analysis and application of chaos in electrical circuits, the analysis of synchronization in coupled oscillatory circuits, and complex networks. He was the Chair of the IEEE CAS Society Technical Committee on Nonlinear Circuits and Systems (NCAS) (2004–2005), the Steering Committee Secretary of the IEICE Research Society of Nonlinear Theory and its Applications (NOLTA) (2004–2007), the Chair of the IEEE CAS Society Shikoku Chapter (2011–2014), a member of the IEEE CAS Society Board of Governors (2012–2017), and Vice President of Regional Activities and Membership of the IEEE CAS Society (2018–2021). He is currently serving as the Vice President of Financial Activities of the IEEE CAS Society (from 2023). He was an Associate Editor of IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS–I: REGULAR PAPERS (2004–2005), IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS–II: EXPRESS BRIEFS (2012–2013 and 2016–2019), and IEEE CAS MAGAZINE (2008–2009). He is currently serving as a Secretary for the NOLTA, IEICE (from 2009), and as an Associate Editor for the IEEE CAS SOCIETY NEWSLETTER (from 2007) and the International Journal of Bifurcation and Chaos (from 2015). He is also a member of the Editorial Board of the International Journal of Circuit Theory and Applications.

Yoko Uwate received the B.E., M.E., and Ph.D. degrees in Electrical and Electronic Engineering from Tokushima University, Tokushima, Japan, in 2003, 2005, and 2006, respectively. From October 2006 to March 2008, she was a Post-Doctoral Research Fellow (PD) of the Japan Society for the Promotion of Science (JSPS) with Tokushima University, and she was also a Visiting Post-Doctoral Research Fellow with the Institute of Neuroinformatics (INI), University of Zurich, and with ETH Zurich, Switzerland. From April 2008 to March 2010, she worked as a Post-Doctoral Fellow for research abroad for JSPS at the Institute of Neuroinformatics (INI), University of Zurich, and at ETH Zurich. Since April 2010, she has been working at Tokushima University, where she is currently an Associate Professor. Her research interests include complex phenomena in chaotic circuits and neural networks. Dr. Uwate is a member of the IEEE CAS Society Board of Governors (2013 to 2015, and 2021 to present). She was the Chair of the IEEE CAS Society Technical Committee on Neural Systems and Applications (NSA) (2019 to 2021). Now, she is the DEI (Diversity, Equality, and Inclusion) Committee Chair of the IEEE CAS Society (since May 2022). She was an Associate Editor of IEEE Transactions on Circuits and Systems I: Regular Papers (2012 to 2013) and IEEE Transactions on Circuits and Systems II: Express Briefs (2017 to 2019). She has been an Associate Editor of the IEEE CAS Society Newsletter since 2012.

An SRAM-Based Transpose Compute-In-Memory Macro Utilizing Programmable Single-Slope SAR ADC

Xin Zhang¹⁾, Youngjun Jo and Tony¹⁾, and Tae-Hyoung Kim¹⁾

¹⁾School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore, Korea.

Email: xin010@e.ntu.edu.sg / yongjun001@e.ntu.edu.sg / thkim@ntu.edu.sg

Abstract: This work proposes a transpose SRAM-based compute-in-memory (CIM) macro for accelerating both inference and training in convolutional neural networks (CNN). The transpose structure achieves higher processing throughput and energy efficiency from the high parallelism of bit-cell CIM operation in one processing cycle. This work also proposes a programmable single-slope (SS) successive approximation (SAR) ADC for energy efficiency improvement by utilizing the probability density function of MAC values. The test chip was fabricated by 180nm CMOS technology and achieved an energy efficiency of 6.61 TOPS/W with the ADC zero-skip and SS operations.

Keywords: multiply and accumulate, convolutional neural network, compute-in-memory, transpose array, zero-skip

Introduction

With the explosion of data and comprehensive utilization of artificial intelligence (AI) algorithms for data processing, the traditional Von Neumann computing system faces high-speed processing challenges. Compute-in-memory (CIM), combining computation and storage functions, is highly introduced as a promising method [1]. Most reported works have focused on forward (FWD) data propagation for inference. However, in the training stage, backward (BWD) error propagation also occupies a significant processing time and power consumption. In this work, we propose a 9T SRAM-based CIM macro [2] with local transpose processing bit-cell which improves the throughput and energy efficiency in both inference and training compared to the prior arts.

Proposed CIM Macro

Fig. 1 (a) illustrates the structure of the 9T SRAM bit-cell. Three additional transistors (M6~M8) are added in the standard 6T bit-cell to realize transpose processing symmetrically. Fig 1 (b) shows the overall structure of the CIM macro, which consists of three parts: 1) the core array including FWD/BWD mode replica rows/columns, 2) input drivers, and 3) ADCs. The FWD and BWD propagation are symmetrically realized in the CIM macro. For both CIM operations, input data are firstly converted into pulses and applied to the array. Then the pre-charged output lines are discharged by the relative bit-cells depending on the stored weight. Finally, ADCs convert the voltages from the output lines to 6-bit digital MAC values.

As shown in Fig. 2, for the programming purpose, the proposed 6-bit programmable single-slope SAR (PSS-SAR) ADC implements the single-slope (SS) operation by splitting the capacitors of the capacitive-DAC in the ADC. Using the probability density function of MAC results, the number of SS steps is adjusted from zero to three for energy efficiency. As an event-driven operation, PSS-SAR converts the first input signal with the SS function from the ADC enable signal and finishes with the last end-of-conversion signal y . The proposed ADC also supports the ReLU-based zero skip function by the SS operation to reduce energy consumption.

Experimental Results

The proposed transpose CIM macro was fabricated in 180nm technology. SS-SAR ADC supports the ReLu-based zero-skip function and can reduce power consumption by 46.2% per MAC operation and 13.9% per classification. 48 runs of the measured ADC results sweeping from the minimum to the maximum value show satisfying linearity in the full range. Fig. 3 shows the energy and the linearity of the proposed CIM macro. A handwritten digit image database MINST was utilized for accuracy testing and 95.92% accuracy is obtained.

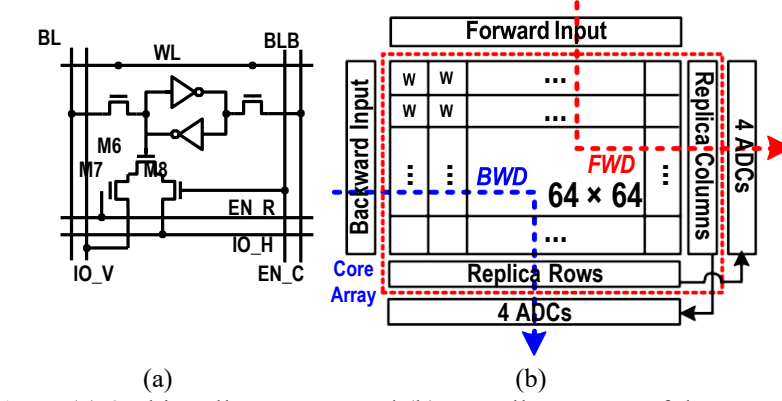


Figure 1. (a) 9T bit-cell structure, and (b) overall structure of the CIM macro

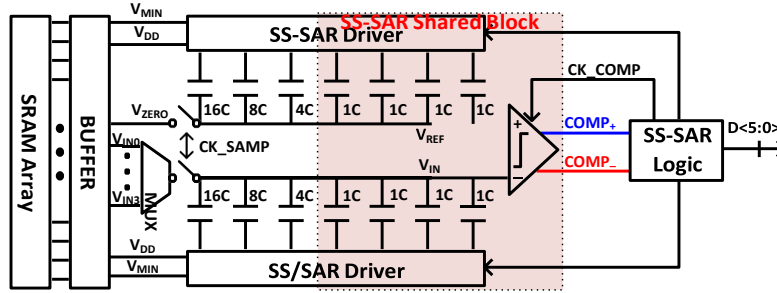


Figure 2. Architecture of programmable SS-SAR hybrid ADC (PSS-SAR).

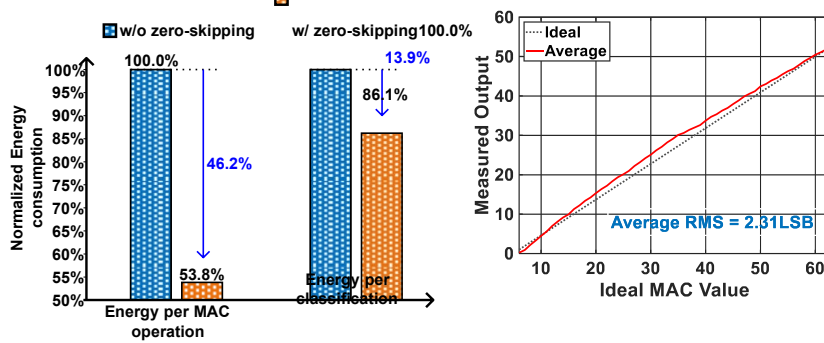


Figure 3. Measured performance

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Biography

Prof. Tony T. Kim received the B.S. and M.S. degrees in electrical engineering from Korea University, Seoul, Korea, in 1999 and 2001, respectively. He received the Ph.D. degree in electrical and computer engineering from the University of Minnesota, Minneapolis, MN, USA in 2009. From 2001 to 2005, he worked for Samsung Electronics where he performed research on the design of high-speed SRAM memories, clock generators, and IO interface circuits. In 2007 ~ 2009 summer, he was with IBM T. J. Watson Research Center and Broadcom Corporation where he performed research on isolated NBTI/PBTI measurement circuits and SRAM Mismatch measurement test structure, and battery-backed memory design, respectively. In November 2009, he joined Nanyang Technological University where he is currently an associate professor. His current research interests include in-memory computing for edge computing, emerging memory circuit design, energy-efficient circuits and systems for IoT and wearable devices, variation and aging tolerant circuits and systems, and circuit techniques for 3-D ICs.

A hybrid WPT System for Achieving CC/CV Switching

Jianxin Yan¹⁾, Wenqi Zhu¹⁾, Yinchun Xie¹⁾, and Hiroo Sekiya¹⁾

Graduate School of Information Science, Chiba University, Chiba, Japan.

E-mail: sekiya@faculty.chiba-u.jp

Abstract: This paper proposes a load-independent high frequency wireless power transfer (WPT) system that achieves the switching between constant current (CC) and constant voltage (CV) outputs. The proposed circuit adds a single switch element to the receiver, alters the compensation circuit, and combines it with a load-independent class-E inverter to achieve CC/CV switching. As a result, the CC/CV transition is completed on the receiver without wireless communication from the transmitter, and the class-E inverter achieves zero-voltage switching (ZVS) through load-independent operation. The obtained results validated the design approach.

Keywords: WPT; CC; CV; ZVS

Introduction

The wireless power transfer (WPT) system has been the focus of various applied research efforts toward societal implementation. Applications include robot arms [1] and electrical bicycles [2]. Many of these applications involve WPT systems designed for battery charging. To achieve rapid battery charging, constant current (CC) and constant voltage (CV) control are effective. However, during CC/CV control, the load seen by the charging circuit undergoes significant fluctuations. Therefore, maintaining high efficiency in the charging circuit needs a complex control structure [3].

In recent years, the load-independent class-E WPT system has gained attention for its high robustness to load variations. This circuit can achieve zero-voltage switching (ZVS) and either CC or CV output without control. However, the load-independent class-E WPT system can only realize either CC or CV output in a single circuit. Additionally, a circuit combining two load-independent inverters has been proposed for CC/CV mode switching. Because the switching for CC/CV mode is present in the transmission circuit, communication equipment from the receiving circuit to the transmission circuit is necessary, leading to circuit complexity.

This paper proposes a load-independent high-frequency WPT system that achieves the switching between CC and CV outputs. The proposed circuit adds a single switch element to the receiver, alters the compensation circuit, and combines it with a load-independent class-E inverter to achieve CC/CV switching. As a result, the CC/CV transition is completed on the receiver without wireless communication from the transmitter, and the class-E inverter achieves ZVS through load-independent operation. We analyze the proposed system and introduce a design methodology based on analytical expressions. The obtained results validated the design approach.

Proposed WPT System

Figure 1 shows a system topology of the proposed WPT system. It consists of a load-independent class-E inverter, an inductive coupling part with a compensation circuit, and a current-driven class-D rectifier. Switches S_1 and S_2 are applied for changing the CC/CV modes, which are implemented by a single switch component. For CV mode, both S_1 and S_2 are off, the resonant components of L_s and C_{s1} are designed so that the voltage gain $G = V_O/V_I$ is independent of load resistance, where V_O is the mean value of output voltage v_O , and V_I is the input dc-voltage source. For CC mode, S_1 and S_2 are on. The component values of L_c and C_{s2} are determined for constant transconductance $F = I_O/V_I$ regardless of load resistance, where I_O is the mean value of output current i_O . For achieving the load-independent operation, the input reactance of the receiver should be constant for both modes against battery-load variations, which is the additional restrictive condition for determining the compensation network component values.

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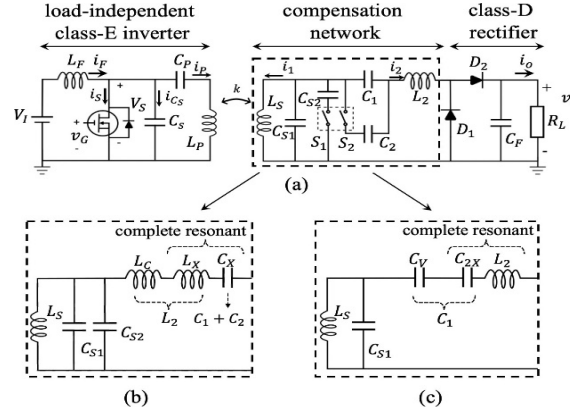


Figure 1. SEQ Figure * ARABIC 1: Topology of the proposed circuit. (b) Equivalent circuit for CC mode. (c) Equivalent circuit for CV mode.

Figure 1(b) and (c) show the equivalent circuit for CC and CV modes. Assuming that the inverter's output is CV, as shown in Fig. 1(c), when both S_1 and S_2 are off, it is an SP coupling structure whose output is CV. As shown in Fig. 1 (b), when both S_1 and S_2 are on, C_{s2} and C_2 are added. The resonant capacitance increases by C_2 compared to Fig. 1(c). As a result, the C_x-L_2 structure is inductive. We divide the L_2 into two parts, named L_c and L_x . L_x and C_x are in complete resonance, and the remaining components L_c and C_{s2} constitute a new resonant structure, which reverses the output characteristics from the CV mode in Fig. 1 (c) to CC mode in Fig. 1 (b). Therefore, by switching the topology of the compensation circuit located on the receiver side using S_1 and S_2 , it is possible to achieve the switching of CC/CV outputs.

Circuit Experiment

A. Design Specification

To verify the usefulness of the proposed WPT system, a circuit experiment is conducted. In this paper, the following specifications are given: input voltage $V_I = 7$ V, operating frequency $f = 1$ MHz, CC output current $I_O = 1$ A, CV output voltage $V_O = 24$ V, and the OFF duty ratio $D = 0.48$. For the purpose of CC/CV mode switching, the load resistance $R_{Lr} = 24 \Omega$ and defined as the rated resistance in the design. Therefore, CC mode is employed for $R_L/R_{Lr} \leq 1$, and CV mode is employed for $R_L/R_{Lr} > 1$. These specifications provide the basis for designing and optimizing the circuit parameters to achieve the desired CC/CV mode operation.

B. Experimental Waveform

Figure 2 shows the measured experimental waveforms. It can be observed that the proposed circuit achieved an output current in the range of $0.87 \text{ A} \leq I_O \leq 1.07 \text{ A}$ in CC mode and an output voltage range of $20.3 \text{ V} \leq V_O \leq 24.6 \text{ V}$ in CV mode. A noteworthy observation is the consistent attainment of ZVS in both CC and CV modes, regardless of load variations. Furthermore, the class-E inverter has achieved a load-independent condition because the output reactance of the class-E inverter remains constant

despite load variations. The experimental waveform confirms that the proposed circuit design successfully maintains ZVS operation. Figure 3 shows the measured values of output voltage and current.

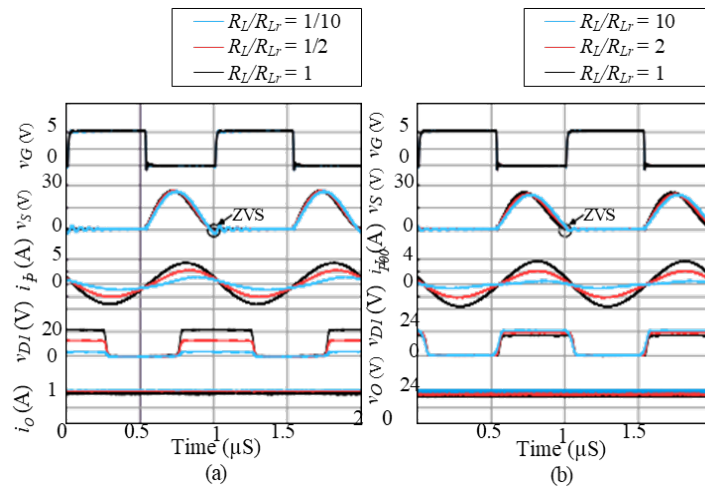


Figure 2. SEQ Figure * ARABIC 2: Experimental waveform in: (a) CC mode and (b) CV mode.

Conclusion

This paper proposes a load-independent high frequency wireless power transfer (WPT) system that achieves the switching between constant current (CC) and constant voltage (CV) outputs. The proposed circuit adds a single switch element to the receiver, alters the compensation circuit, and combines it with a load-independent class-E inverter to achieve CC/CV switching. As a result, the CC/CV transition is completed on the receiver without wireless communication from the transmitter, and the class-E inverter achieves zero-voltage switching (ZVS) through load-independent operation. The obtained results validated the design approach.

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The Problem of Signal Extraction Based on Sweep Sine for EIS System and Its Solution

En-Chi Yang¹⁾ and Shin-Chi Lai^{2,)}*

¹⁾Dept. of Electronic Engineering, National Yunlin University of Science and Technology, Taiwan.

²⁾Dept. of Automation Engineering, National Formosa University, Yunlin, Taiwan.

E-mail: shivan0111@nfu.edu.tw

Abstract: This study conducted an analysis of the sweep sine stimulus input signal required for EIS measurement systems. The results revealed that signals below 600Hz would result in significant impedance distortion. Therefore, in practical applications, it will be necessary to reevaluate measurements within this frequency range and provide multiple mixed sine waves at specific frequencies.

Keywords: Biosensor, Fourier Transform (FT), Electrical Impedance Spectroscopy (EIS), Impedance Calculation.

In the modern fields of science and engineering, Electrochemical Impedance Spectroscopy (EIS) has always been a crucial experimental and analytical technique. It allows for non-destructive measurements with advantages such as minimal system interference, rapid response, and reliable results. Furthermore, this measurement technique can use small-amplitude stimulus signals, significantly reducing the risk of damage to the Device Under Test (DUT). Therefore, EIS technology is widely applied in the characterization of electrical systems and batteries (state of charge, state of health, and remaining useful life [1-2]), the biotechnological field (analysis of skin conditions, cell growing and differentiation monitoring [3-4]). Generally, EIS technology can choose a single frequency or a broadband signal as the stimulus signal [5]. When using a single frequency for measurement, it is necessary to progressively adjust the desired measurement frequency, and the measurement time depends on the number of frequency points. On the other hand, using a single frequency concentrates the energy on the fundamental frequency, resulting in a higher Signal-to-Noise Ratio (SNR). The technique of multi-frequency measurement involves using mixing multiple sinusoids as the stimulus signal, and through FFT, the required frequency point information can be calculated all at once, resulting in less measurement time. Therefore, the sweep sine form of stimulus signal as shown in Fig. 1 is commonly applied in calculating the impedance of EIS systems. Due to the rapid variation of frequency over time in the sweep sine signal, when performing FFT for spectrum transformation, we observe more pronounced distortion in the low-frequency signals, as shown in Fig. 2. Here, we observe that for frequencies beyond 600Hz, the majority of the measurement results exhibit an error rate below 0.3%. On average, the error rate stabilizes consistently below 0.3% after 600Hz.

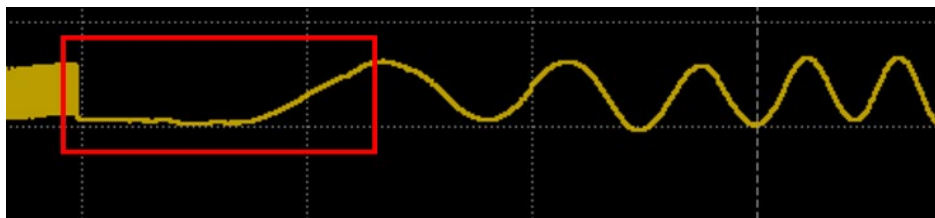


Figure 1. Sweep Sine for Stimulus Signal in EIS System

On the other hand, in the frequency range of approximately 600Hz to 1000Hz, the error rate gradually increases. Below 600Hz, there is a significant upward trend in the error rate. To address the low-frequency distortion caused by using sweep sine as the stimulus signal, we need to generate a sine wave with multiple frequencies and then recalculate the impedance information. The inherent frequency of

this sine wave must be less than or equal to 600Hz. Currently, we have only selected 5 frequency signals ranging from 1 to 600 Hz, *i.e.* 20Hz, 100Hz, 250Hz, 330Hz, 550Hz, for experimentation. The results indicate that we can achieve improved impedance measurement results, as shown in Fig. 3.

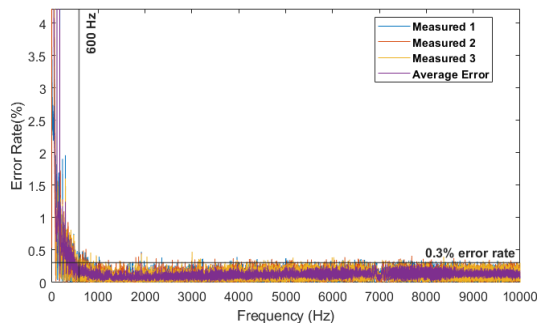


Figure 2. Error Rate of Sweep Sine Measured Result

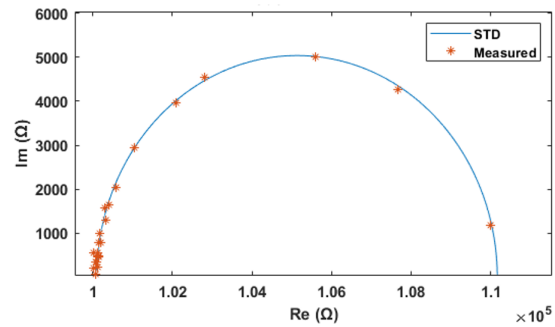


Figure 3. Nyquist Plot for EIS Impedance Calculation

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Biography

Shin-Chi Lai was born in Taichung, Taiwan, R.O.C., in 1980. He received a B.S. degree in Electronic Engineering from ChienKuo Technology University, Changhua, Taiwan, in 2002. Then, he received his M.S. degree in Electronic Engineering from National Yunlin University of Science and Technology, Yunlin, Taiwan, in 2005. Recently, he received the Ph.D. degree at National Cheng Kung University, Tainan, Taiwan, in 2011. From Oct. 2011 to Jul. 2013, he had been an assistant research fellow of the department of electrical engineering at National Cheng Kung University, Tainan, Taiwan.

En-Chi Yang was born in Nantou in 1994. He received the B.S. degree from the Department of Computer Science and Information Engineering, Nanhua University, Chiayi, Taiwan, and the M.S.

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degree from the Master Program of Green Technology for Sustainability, Nanhua University, Chiayi, Taiwan. He is currently a Ph.D. student in the Department of Electronic Engineering at the National Yunlin University of Science and Technology, Yunlin County, Taiwan.