

Lecture Notes in Networks and Systems 447

Xin-She Yang
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Nilanjan Dey
Amit Joshi *Editors*

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Lecture Notes in Networks and Systems

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Amit Joshi
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Preface

The Seventh International Congress on Information and Communication Technology will be held during 21–24 February 2022 in a hybrid mode and organised by Global Knowledge Research Foundation. The associated partners were Springer and InterYIT IFIP, Activate Learning, City of Oxford College, UK. The conference will provide a useful and wide platform both for display of the latest research and for exchange of research results and thoughts. The participants of the conference will be from almost every part of the world, with backgrounds of either academia or industry, allowing a real multinational multicultural exchange of experiences and ideas.

A great pool of more than 1100 papers were received for this conference from across 95 countries among which around 300 papers were accepted and will be presented through digital platforms during the two days. Due to the overwhelming response, we had to drop many papers in the hierarchy of the quality. Total 42 technical sessions will be organised in parallel in 4 days along with a few keynotes and panel discussions in hybrid mode. The conference will be involved in deep discussion and issues which will be intended to solve at global levels. New technologies will be proposed, experiences will be shared, and future solutions for design infrastructure for ICT will also be discussed. The final papers will be published in four volumes of proceedings by Springer LNNS Series.

Over the years, this congress has been organised and conceptualised with collective efforts of a large number of individuals. I would like to thank each of the committee members and the reviewers for their excellent work in reviewing the papers. Grateful acknowledgements are extended to the team of Global Knowledge Research Foundation for their valuable efforts and support.

I look forward to welcoming you to the 7th Edition of this ICICT Congress 2022.

Amit Joshi, Ph.D.
Organising Secretary, ICICT 2022
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Contents

Smart Wearable Shoes Using Multimodal Data for Visually Impaired	1
Ann Nosseir	
Conceptual Framework of Database Development on Bidong Island: The Case Vietnamese Boat People (VBP) Campsite Facilities for Historical Tourism	19
Dazmin Daud, Nursyamillah Annuar, and Antashah Mohd Nor	
An Evaluation of Techniques for Classification of Conditional Sentences and Their Structural Components	29
G. B. Sanjana, Sundar Guntnur, and Shivali Agarwal	
Design of an Assistive Low-Cost 6 d.o.f. Robotic Arm with Gripper	39
Vasile Denis Manolescu and Emanuele Lindo Secco	
An Improved Method for the Sizing of a Stand-Alone Photovoltaic System: Application at Ngoundiane Village in Senegal	57
Pape Made Diouf, Amy Sadio, Papa Lat Tabara Sow, Ibrahima Fall, and Senghane Mbodji	
Blockchain Based Software Engineering Requirements Analysis and Management	75
Bandar Ali Alrami AL Ghadmi, Omar Ahmed Abdulkader, and Ahmad Abdulaziz Alwarhi	
Computer Simulation of the Response of a Semiconductor Wafer with a Self-Affine Pattern in the Form of a System of Coupled Ring Grooves to Electromagnetic Radiation	85
Gennadi Lukyanov, Alexander Kopyltsov, and Igor Serov	

The Computer Engineering in ECG Analysis Based on Scatter Mapping	93
Svetlana Aleksandrova, Irina Kurnikova, Marina Aleksandrova, Nikolay Kislyy, Tatiana Kochemasova, and Maria Zavalina	
Traffic Disturbance Mining and Feedforward Neural Network to Enhance the Immune Network Control Performance	99
Ali Louati, Fatma Masmoudi, and Rahma Lahyani	
The Use of ICT in Personalizing Self-learning in Time of Crisis: A Human Computer Interaction Perspective in a Developing Country	107
Ghada Refaat El Said	
Advanced Processing and Classification of Plant Disease	127
Sufola Das Chagas Silva E Araujo, V. S. Malemath, and K. Meenakshi Sundaram	
Design of an Interactive BB8-Like Robot	137
Mia Innes and Emanuele Lindo Secco	
Transfer Learning in Deep Reinforcement Learning	145
Tariqul Islam, Dm. Mehedi Hasan Abid, Tanvir Rahman, Zahura Zaman, Kausar Mia, and Ramim Hossain	
A Novel Current Control Scheme for Grid-Connected Single-Phase PWM Bridgeless Power Converters	155
Khalid Javed, Lieven Vandeveld, and Frederik De Belie	
Disk Space Management Automation with CSI and Kubernetes	171
Anastasia Shemyakinskaya and Igor Nikiforov	
Accuracy of Potentiometric Methods for Measuring Ion Activity in Solutions	181
O. M. Vasilevskyi, V. M. Sevastianov, K. V. Ovchynnykov, V. M. Didych, and S. A. Burlaka	
Evaluating Effect of Microsoft HoloLens on Extraneous Cognitive Load During Simulated Cervical Lateral Mass Screw Placement	191
Dmitriy Babichenko, Edward G. Andrews, Stephen P. Canton, Eliza Beth Littleton, Ravi Patel, Dukens Labaze, and Andrew Mills	
Network Modeling—A Convenient Way to Study IP Networks	203
Ivan Nedyalkov and Georgi Georgiev	
A New Innovation Concept on End-user’s Contextual and Behavioural Perspectives	213
Reem Aman, Shah J. Miah, and Janet Dzator	

Computational Modelling of the Role of Leadership Style for Its Context-Sensitive Control Over Multilevel Organisational Learning 223
 Gülay Canbaloglu, Jan Treur, and Anna Wiewiora

Enumeration of LCD and Self-dual Double Circulant Codes Over $\mathbb{F}_q[v]/\langle v^2 - 1 \rangle$ 241
 Shikha Yadav and Om Prakash

Autonomous Dysfunction and the Phenomenon of Early Aging of Regulatory Systems 251
 Irina Kurnikova, Shirin Gulova, Ramchandra Sargar, and Nikolay Kisliy

Principles for Assurance on Corporate Governance of ICT 257
 Petrus M. J. Delpont and Rossouw Von Solms

The Role of Telecommunication Technology During COVID-19 Pandemic in Indonesia 275
 Vina Fujiyanti, Syifaul Fuada, and Nadia Tiara Antik Sari

Online Purchase Over Pandemic Covid-19: Its Growth and Future in Malaysia 285
 Tang Mui Joo and Chan Eang Teng

MAGNeto: An Efficient Deep Learning Method for the Extractive Tags Summarization Problem 297
 Hieu Trong Phung, Anh Tuan Vu, Tung Dinh Nguyen, Lam Thanh Do, Giang Nam Ngo, Trung Thanh Tran, and Ngoc C. Lê

Design and Development of a Mobile Outdoor AR Application for On-Site Visualization of Wind Turbines 311
 Simon Burkard and Frank Fuchs-Kittowski

An Incorporated Solution to Support Elder People in Staying in Their Familiar Surroundings 323
 Dominic Mircea Kristaly and Sorin-Aurel Moraru

Analysis of Indoor Localization Using Beacons for the Visually Impaired: A Systematic Literature Review 339
 Juan Surco-Anacleto and Michael Cabanillas-Carbonell

Information and Communication Technologies for Employability in Times of COVID-19, a Systematic Literature Review 349
 Jesus Palacios-Loayza, Carlos Ayala-Inca, and Michael Cabanillas-Carbonell

The Acceptance and Challenges of Online Learning over Covid-19 Pandemic 359
 Eang Teng Chan and Mui Joo Tang

Learn to Ask What You Don't Know	369
Binay Dahal, Sing Choi, and Kazem Taghva	
Location-Based Service Discovery for Mobile-Edge Computing Using DNS	379
Kurt Horvath, Helmut Wöllik, Uran Christoph, and Valentin Egger	
Promoting Viable Supply Chain Management (SCM) in the Nigeria Agro-Allied Industry Using Internet of Things	389
Makinde Oluwafemi Ajayi and Opeyeolu Timothy Laseinde	
Recovery System of Work Performance by Using Indoor Environmental Changes Based on EEG-Movement Feature Space	401
Hinata Serizawa and Yoshihisa Fukuhara	
Moroccan Sign Language Video Recognition with Deep Learning	415
Abdelbasset Boukdir, Mohamed Benaddy, Othmane El Meslouhi, Mustapha Kardouchi, and Moulay Akhloufi	
Home Automation System and Quality of Life in Low-Income Households: A Systematic Review of the Literature from 2010 to 2021	423
Jenifer Diana Bustamante-Gonzales, Hugo Eladio Chumpitaz-Caycho, and Franklin Cordova-Buiza	
Detecting Termites in Wood Structure Using Internet of Things Approach	431
Nur Zaimah Ahmad, Lutfil Hadi Zaifri, Bazilah A. Talip, and Aznida Abu Bakar Sajak	
Performance Evaluation of Boosted 2-Stream TCRNet	443
Shah Hassan, Md Jibanul Haque Jiban, and Abhijit Mahalanobis	
Design of a Cascaded Single-Phase Multilevel Inverter for Photovoltaic Applications	451
Darío Fernando Yépez Ponce, Héctor Mauricio Yépez Ponce, and William Manuel Montalvo López	
An IoT Architecture to Enhance Monitoring and Predictive Maintenance for Cultural Heritage Buildings	461
Mario Casillo, Massimo De Santo, Marco Lombardi, Rosalba Mosca, Domenico Santaniello, and Carmine Valentino	
A BIM-Based Approach for Decision Support System in Smart Buildings	471
Francesco Colace, Caterina Gabriella Guida, Brij Gupta, Angelo Lorusso, Francesco Marongiu, and Domenico Santaniello	

Deficiencies of Computational Image Recognition in Comparison to Human Counterpart 483
 Vladimir Vinnikov and Ekaterina Pshehotskaya

Electronic Health Record’s Security and Access Control Using Blockchain and IPFS 493
 Md. Yeasin Ali, Suhaib Ahmed, Muhammad Iqbal Hossain, A. B. M. Alim Al Islam, and Jannatun Noor

Implementing Butterfly Key Expansion Using Post-Quantum Algorithms 507
 Ahmad Salman and Zachary Blankinship

Perceived Readiness of Information and Communication Technology Policy in Supporting Mobile Learning in Times of COVID-19 at South African Schools 517
 Baldreck Chipangura

Application of Random Forest Model in the Prediction of River Water Quality 525
 Turuganti Venkateswarlu and Jagadeesh Anmala

Supervised Learning-Based PV Output Current Modeling: A South Africa Case Study 537
 Ely Ondo Ekogha and Pius A. Owolawi

Use of Social Networks by Russian Politicians 547
 Olga Gris and Anna Sosnovskaya

Design and Implementation of Verifiable Blockchain-Based e-voting System 557
 Seiwoong Choi, HeeSeok Choi, and Kwang Sik Chung

DevOps Best Practices in Highly Regulated Industry 567
 Ruth G. Lennon

Citizens’ Use of Social Media: A Thematic Analysis on Digital Co-Production in Disaster Management 587
 Vicente A. Pitogo and Jesterlyn Q. Timosan

Robot Welding Path Planning and Application Based on Graphical Computing 597
 Jingjing Lou, Xujiang Yu, Yongfei Chen, Zhubing Sun, and Pengfei Zheng

The Interpolation-Vandermonde Method for Numerical Solutions of Weakly Singular Volterra Integral Equations of the Second Kind 607
 E. S. Shoukralla, B. M. Ahmed, Ahmed Saeed, and M. Sayed

Adoption of Cloud-Based Communicable Disease Surveillance in Taiwan: Chief Information Officers’ Perspectives of Hospitals 615
 Pi-Jung Hsieh and Hui-Min Lai

Design and Evaluation of a Novel and Modular Educational Robot Platform Based on Technology Acceptance Model 633
 Avraam Chatzopoulos, Konstantinos Kalovrektis, Apostolis Xenakis, Elefterios Chondrogiannis, Michail Papoutsidakis, Michail Kalogiannakis, and Sarantos Psycharis

Assessing the Effects of Landmarks and Routes on Neuro-Cognitive Load Using Virtual Environment 645
 Usman Alhaji Abdurrahman, Lirong Zheng, and Usman Haruna

On the Transposition of Translator Functions in a Digital Communicative Environment 657
 Lyudmila Kushnina, Elena Alikina, Irina Perlova, Kristina Permiakova, and Marina Khudaiberdina

Factors Affecting Intelligent Enterprise Resource Planning System Migrations: The South African Customer’s Perspective 665
 Precious Mushayi and Thembekile Mayayise

Analysis of an Efficient ZnO/GeTe Solar Cell Using SCAPS-1D 677
 Mostafa M. Salah, A. Zekry, Mohamed Abouelatta, Ahmed Shaker, Mohamed Mousa, and Ahmed Saeed

Looping Through Color Space: A Simple Augmentation Method to Improve Biased Object Detection 687
 Pascal Lampert, Janis Jung, Andreas Hubert, and Konrad Doll

Detection of Retinopathy of Prematurity Stages Utilizing Deep Neural Networks 699
 Nazar Salih, Mohamed Ksantini, Nebras Hussein, Donia Ben Halima, Ali Abdul Razzaq, and Sohaib A. Mahmood

Iterative Approach for Reduction of Index-2 Periodic Models Using Generalized Inverse Procedure 707
 Atia Afroz, Mohammad-Sahadet Hossain, Musannan Hossain, and Mashrur Wasek

Smart Village Crop Planning: Enhancing Farmer’s Decision-Making Culture with Data-Driven Predictive Model 717
 Ariza Nordin and Faizah Ahmad Faizar

Closed-Domain Multiple-Choice Question Answering System for Science Questions 729
 Kedar P. Vaidya, Sanya A. Chetwani, and Mansi A. Radke

Quality Management Within and Visiting e-cultural Tourist Destinations: Case Study Rural Parish of San Miguelito 743
Alicia Porras-Angulo, Alba Hernández-Freire, Johana Porras-Quispe, and Adriana Cuesta-Chiriboga

Use of GeoGebra in Learning to Solve the Problem of Calculating the Root of a Nonlinear Equation 753
Judith Keren Jiménez-Vilcherrez, Felicita Marcela Velásquez-Fernández, Araceli Margarita Acevedo-Ruiz, Ricardo Velezmoro-León, and Robert Ipanaqué-Chero

Usability Evaluation Using Unmoderated Remote Usability Testing on Angkasa LMS Website Case Study 761
Veronikha Effendy, Dana Sulistiyo Kusumo, Nungki Selviandro, and Kusuma Ayu Laksitowening

Distributed Deep Reinforcement Learning for Resource Allocation in Digital Twin Networks 771
Jie Luo, Jie Zeng, Ying Han, and Xin Su

The COVID-Enforced Adoption of Technology for Reluctant Entrepreneurial Businesses: A Systematic Literature Review 783
Gareth Mclean and Adriana A. Steyn

Integrated Remote Primary Care Infrastructure: A Framework for Adoption and Scaling of Remote Patient Management Tools and Systems 797
Barimwotubiri Ruyobeza, Sara S. Grobbelaar, and Adele Botha

A Comprehensive Virtual Classroom Dashboard 819
Amber Kimberling and Sampson Akwafuo

Freddy Render: A Horizontally Scaled Blender-Based Solution for 3D Graphics Rendering 829
Mike Peralta and Sampson Akwafuo

Medical X-Ray Image Classification Employing DCGAN and CNN Transfer Learning Techniques 839
Md. Asif Talukdar, Ayesha Siddika, Ahasanul Haque Abir, Mohammed Ziad Hassan, and Muhammad Iqbal Hossain

A Survey on Counterfeits in the Information and Communications Technology (ICT) Supply Chain 849
Samar Saleh, Rong Lei, Weihong Guo, and Elsayed A. Elsayed

Banking Credit Risk Analysis using Artificial Neural Network 871
Charles Maruma, Chunling Tu, and Claude Nawej

Implementation, Analysis, and Emulation of Electric Vehicle Powertrain System with Sensorless Field Controlled PMSM Drive 879
Monika Verma, Mini Sreejeth, and Madhusudan Singh

Verification of the Effectiveness of Learning Materials that Support Self-regulation for Learning Considering Differences in Career Resilience: Acquiring Knowledge of Level 3 Automated Driving Vehicles 889
Maki Arame, Junko Handa, Yoshiko Goda, Masashi Toda, Ryuichi Matsuba, Huiping Zhou, Makoto Itoh, and Satoshi Kitazaki

ICT-Enabled Vehicle Theft Detection and Recovery System 901
Kamlesh Kumawat and Vijay Singh Rathore

Determination of Antibiotic Resistance Level in *Klebsiella* using Machine Learning Models 913
Snehal Gupta, Sreemoyee Chatterjee, Amita Sharma, Marina Popolizio, Vincenzo Di Lecce, Mariantonietta Succi, Patrizio Tremonte, Rita Dario, and Vijay Singh Rathore

Author Index 925

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Smart Wearable Shoes Using Multimodal Data for Visually Impaired



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Abstract The visually impaired people’s ultimate goal is to walk freely and comfortably indoors and outdoors. They fear to hit into steps, stones, or uneven floor. Wearable technologies whether image-based or sensors-based provide a solution. However, image-based technologies have issues of detecting an obstacle accurately with no delay. The sensors-based technologies have limitations of the data quality. Therefore, the sensors need to be fitted closer to the obstacles to capture the data, and they require filter to remove the noise data. This work presents a novel wearable, simple, low-cost, user-friendly device. It supports visually impaired to walk in different areas. The system provides accurate data to support visually impaired detecting the obstacles surround them, i.e., front, left, right, and back. It works in multiple environments. The shoes will help them to walk indoors and avoid obstacles on the floor. In outdoors, like pedestrian road, parks, or forests, it will detect pit holes and pumps. The proposed system consists of three parts. The first part, which is a low-cost Internet of things (IoT) system, attaches sensors to shoes to collect data about the context. The second part works like a filter to remove the noise data. Four anomaly machine learning algorithms are applied to choose the most accurate—K-NN, SVM, decision tree, and random forest. The third part is a risk level assessment using fuzzy rules. The results of comparing the anomaly algorithms accuracy show that the random forest is 0.99 with a std. dev ± 0.01 . The fuzzy rules defined the three different ranges for the levels of risk.

Keywords Fuzzy systems · Health and safety · Supervised learning · Internet of things · Wearable computers

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1 Introduction

Statistics in 2020 [1] by the World Health Organization (WHO) show that there is one billion visually impaired persons globally. They cannot see clearly in nearby distance. This is caused by different factors such as uncorrected refractive errors, cataract, or age-related macular degeneration. The percentage of the visually impaired is four times in the low- and mid-income regions than in the high-income regions. This is due to the lack of appropriate eye healthcare services. Additionally, the percentage of impaired people becomes higher with elderly. There is as well a number of visually impaired in young age people [2]. They face a number of difficulties in indoors and mostly outdoor environments. Riazi et al. [3] research shows that the main difficulties the visually impaired face in the outdoor environment are unsafe sidewalks, existence of obstacles on sidewalks, walking into glass doors, and others. Additionally, visually impaired fear the most tumbling down from stairs, falling into holes or pits, and bumping into objects in footpaths. To avoid these difficulties, they use the conventional navigation aids such as cane stick or dogs.

Recently with the development of technology, a number of assistive devices developed to support impaired vision people. The WHO classifies these assistive devices into three categories: electronic travel aids (ETAs), electronic orientation aids (EOAs), and position locator devices (PLDs). The ETAs devices give information about environment conveyed by the sensory modality. The EOAs devices inform impaired vision with the direction. The PLDs enable sending GPS position for tracking or in case of an emergency [4].

These devices provide vital information for visually impaired. Considering that the visually impaired people first priority is to walk freely in the street; EOAs and PLDs are supportive. In unfamiliar environments, ETAs devices give impaired people mobility and inform them with risks of different outdoors problems like hitting obstacles and others. ETAs devices provide more information than the conventional navigation tools because these devices have sensing input units that receive inputs from the environment. ETAs devices and especially wearable technologies allow hands-free and portability. Blind and impaired people receive information from these technologies about uneven floor, stones, or holes to prevent them from crippling. Having a smart wearable shoes enables recognizing these obstacles immediately as the sensors are located closer to these obstacles.

This work presents a novel smart wearable shoe. It is not only alerting visually impaired with obstacles in the streets, but also it gives details about the location of the of obstacles whether it is in front, back, right, or left of the visually impaired and fires. In other words, it works in multiple environments. It as well uses machine learning techniques to filter noise, i.e., anomaly data from the sensors. It gives also information of the obstacles risk level.

The paper starts with discussing the related work of detecting obstacles for visually impaired. This is followed by the description of the system's framework. In the third section, the details of sensors attached to the shoes are presented. In the fourth section, four anomaly machine learning algorithms, namely K-NN, SVM, decision tree, and