

6th International Conference on Information Technology Research - ICITR 2021

1st - 3rd, December 2021, Faculty of Information Technology
University of Moratuwa, Sri Lanka



ABSTRACTS OF THE PROCEEDINGS OF ICITR 2021





Abstracts of the Proceedings of ICITR 2021

of

6th INTERNATIONAL CONFERENCE ON
INFORMATION TECHNOLOGY RESEARCH

ICITR 2021

1st – 3rd December 2021

"DIGITAL RESILIENCE & REINVENTION"

Information Technology Research Unit
Faculty of Information Technology
University of Moratuwa
Sri Lanka.

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University of Moratuwa

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International Conference on Information Technology Research

The 6th International Conference on Information Technology Research (ICITR 2021) to be held from 1st to 3rd December 2021. This is an annual event organized by the Information Technology Research Unit (ITRU), which is the research dissemination arm of the Faculty of Information Technology, University of Moratuwa, Sri Lanka. While we regret that the COVID-19 pandemic prevented us from holding the conference physically in the University of Moratuwa, we are continuing to explore the opportunities of holding an innovative virtual conference.

The theme of the conference is "*Digital Resilience & Reinvention*". We are in a Digital Revolution and the Age of Digital Enlightenment. The main focus of this conference is to provide a forum to discuss the rapid advances being made in research and development in Digital Transformation. ICITR is a well-recognized conference in the field of Information and Communications Technology (ICT). The conference scope includes subareas of ICT including but are not limited to Web Intelligence, Network Mobility Management, Embedded Systems, Decision Making and Risk Management, Psycholinguistics and Language Processing, Cognitive Mechanisms of Decision Making, Artificial Intelligence, etc.

ICITR 2021 is technically co-sponsored by IEEE Sri Lanka Section Chapter and IEEE Robotics and Automation Society, Sri Lanka Section Chapter. Financially sponsored by FGS Funding for International Conference and Symposia. All the accepted papers to the ICITR 2021 will be indexed in IEEE Xplore Database. This year the conference received around 160 research papers, and 41 papers were accepted by maintaining the acceptance ratio around 25%.

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Abstracts of the blind-reviewed full papers are included in this conference proceeding.

Message from the General Chair

B. H. Sudantha
General Chair – International Conference on
Information Technology Research (ICITR 2021)



Welcome to the University of Moratuwa and the 6th International Conference on Information Technology Research (ICITR 2021). The objective of the conference is to provide a forum for researchers world-wide to unveil their latest work in Information Technology Research. The theme of the Conference, “*Digital Resilience & Reinvention*” gives the direction, and it covers a broad spectrum of allied fields also.

Maintaining a high quality of a conference requires various levels of involvement including a well-balanced review process. This year, 142 full papers were submitted to the conference. Each paper was subject to review by at least two reviewers, and finally, 41 papers were selected as full paper publications for the conference. I would like to express my sincere thanks to the reviewers for their dedicated, efficient, responsible and rigorous review process, ensuring the high quality of the conference papers. And also, I should be much more thankful to authors who share their research experiences in the conference of their hard work. It helps us prepare proceedings in an excellent level.

Three workshops are organized to benefit the conference participants in various new trends and stimulate their research experiences. A very special thank should go to our four distinguished keynote speakers, Professor Jiang Liu from Waseda University, Japan, Dr. Yogachandran Rahulamathavan, Senior Lecturer and the Programme Director for MSc Cyber Security and Data Analytics at Loughborough University’s London Campus in the United Kingdom, Professor Sunny Joseph Kalayathankal, Jyothi Engineering College, Kerala India and Dr. Sadeep Jayasumana, Senior Research Scientist at Google Research. I would also thank to our invited speaker Mr. Rohan Fernando, Associate Director, Acuity Knowledge Partners.

I would like to thank everyone who has given his or her time, energy and ideas to assist in organizing this event, including all the members of the organizing committee, the TPC Co-Chairs, TPC members and all the reviewers, for the quality and depth of the reviews, and their sense of responsibility and responsiveness under very tight deadlines. In particular, I would like to highlight and acknowledge the tremendous efforts of especially the Director, Information Technology Research Unit, the Editorial Board, ICITR Committees including various energetic Chairs and organizing committees of

workshops and the conference, and finally, our dedicated faculty staff members who gave their support and they worked tirelessly on various conference-related tasks in order to bring the conference to this level and to conquer the challengers raised due to the Covid-19 outbreak.

Finally, we hope that the participants enjoy the outstanding conference program of the 6th International Conference on Information Technology Research ICITR 2021.

Wishing you all a very fruitful and rewarding conference!

Message from the Conference Chair

Dr. Sagara Sumathipala
Director – Information Technology Research Unit



It is my great honour and pleasure to welcome you to the 6th International Conference on Information Technology Research (ICITR 2021). This is an annual event organized by the Information Technology Research Unit, which is the research dissemination arm of the Faculty of Information Technology, University of Moratuwa. While we regret that the COVID pandemic prevented us from holding the conference physically, we are excited about the opportunities of holding an innovative virtual conference. The COVID-19 pandemic has created an unprecedented challenge for society and has highlighted the importance of scientific research.

This year we run the conference under the theme of ***‘Digital Resilience & Reinvention’***. The conference is well recognized as a forum to discuss the rapid advances being made in research and development in Digital Transformation. We are living in extraordinary times. Today, we have adjusted to a new normal of working from home, meeting and shopping online, and generally relying on technology to help us overcome barriers and restrictions on our freedom of movement.

The conference scope covers the whole spectrum of ICT. ICITR 2021 is technically co-sponsored by the IEEE Sri Lanka Section and IEEE Robotics and Automation Society Sri Lanka Section Chapter. All the accepted papers to the ICITR 2021 will be indexed in IEEE Xplore Database. This year we received around 162 research papers, and 41 papers were accepted by maintaining the acceptance ratio of around 25%.

This year’s conference will feature four keynote talks by prominent academic personalities. We wish to welcome our eminent keynote speakers: Professor Jiang Liu from Waseda University, Japan; Dr. Yogachandran Rahulamathavan, Senior Lecturer and the Programme Director for MSc Cyber Security and Data Analytics at Loughborough University’s London Campus in the United Kingdom, Professor Sunny Joseph Kalayathankal, Jyothi Engineering College, Kerala India and Dr. Sadeep Jayasumana, Senior Research Scientist at Google Research, United States. In addition, this year’s conference offers three pre-conference workshops, ten technical sessions, and an invited talk conducted by Mr. Rohan Fernando, Associate Director, Acuity Knowledge Partners. We hope these experts’ varied opinions and comments will be undoubtedly the most informative to the audience present on this day.

Our success greatly depends on many people who have worked tirelessly with us at every stage of the event. I take this opportunity to express my sincere gratitude to the conference chairs for their leadership and all committee members for their tremendous support. I would like to take this opportunity to thank the technical programming committee and all the reviewers for their commitment and dedication towards making this review process a success. I must mention our deep sense of appreciation for the keynote speakers, invited speakers, session chairs and paper evaluation panels. Especially I would like to thank all the authors of the conference proceeding for selecting our conference to publish their valuable research findings. I also extend our sincere thanks to Dr. Maheshi Dissanayake, Chair, IEEE Sri Lanka Section, Dr. Subodha Charles, Secretary, IEEE Sri Lanka Section, Prof. Chandima Pathirana, Chair, IEEE Robotics and Automation Society Sri Lanka Section Chapter, Mr. Tharindu Adhikari, Secretary, IEEE Robotics and Automation Society Sri Lanka Section Chapter, Prof. Ruwan Gopura, Dr. Windhya Rankothge and Dr. Sanath Jayawardana, senior members of IEEE Sri Lanka Section for their tremendous support given to obtain the IEEE Technical Sponsorship for the conference. I wish to express my sincere gratitude to the Faculty of Graduate Studies (FGS), University of Moratuwa, for funding this event to keep down the costs of ICITR 2021.

I would like to express our appreciation to Professor Niranjan Gunawardene, Vice-Chancellor, University of Moratuwa, Mr B. H. Sudantha, Dean, Faculty of Information Technology, Mr. Saminda Premaratne, Head, Department of Information Technology, Dr. Thushari Silva, Head, Department of Computational Mathematics, Dr. Thanuja Sadanayake, Head, Department of Interdisciplinary Studies for their constant support and guidance. In particular, I want to thank the Program Chair, Dr. Subha Fernando, for her wise advice and brilliant suggestions on organizing the technical program.

Especially I would like to express my sincere thanks to the Conference Secretary, Dr. Thilini Piyatilake, Finance Chair, Dr. Isuru Manawadu, Publication Chair, Dr. Upeksha Ganegoda, and all the members of the respective committees for their meticulous work in support of many conference activities. I also would like to express my sincere thanks to Mr. K. B. G. Samantha, Ms. Dulakshi Wageeshani, Mr. Charitha Abeynayake and all the team members for their enormous cooperation in the organization of this event. They are gratefully acknowledged. Last but not least, we would like to thank all of the conference participants for their active participation and inputs. At this challenging time, I urge you all to take care, and I am sure all of you find this conference stimulating, rewarding and meaningful.

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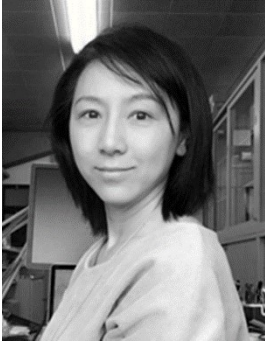
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Keynote Speakers

Keynote Address 1



*Professor Jiang Liu
Waseda University, Tokyo,
Japan.*

Jiang Liu is an Associate Professor at Waseda University in Japan. She obtained her Ph.D. degree in Information and Telecommunications from Waseda University in 2012. After that, she joined the Faculty of Science and Engineering at Waseda University as an assistant professor, and since 2017 she has been an associate professor affiliated with the International Center for Science and Engineering Programs. Her research focuses on Near Field Communication, Wireless Network Systems, and their applications in healthcare industry and 6G network design. She is a senior member of IEEE and a committee member of the Institute of Image Electronics Engineers of Japan (IIEEJ). She also serves as the secretary of the Japan Division for the Institution of Engineering and Technology (IET).

Keynote Title: "Near Field Communication Based Smart Devices and Health Monitoring Systems"

Abstract

Nowadays the spread of the Covid-19 has caused significant changes in society and is triggering many people to develop a new lifestyle. The awareness of vital sign such as blood oxygen saturation concentration (SpO₂) has been improved since SpO₂ can help monitor and detect breathing issues. This motivated us to develop some smart devices to obtain useful vital data continually and easily. In this research direction, Near Field Communication (NFC) technology has attracted much attention in developing sensing systems for health care monitoring and high-secure, short-range data exchange. We design and develop contactless smart devices using NFC technology to obtain the vital data such as pulse rate, SpO₂, blood pressure, blood glucose and others. We also aim to develop some smart devices to recognize human languages or understand human emotions without traditional input interface. To accomplish this goal, we design and test a sensor-based data acquisition glove for Japanese Sign Language (JSL) hand gesture recognition, and a wearable air-writing system that enables users to write the English alphabet in the three-dimensional space without any writing rules. In summary, this discussion delivers an introduction of the non-contact data sensing technology and smart devices along with our latest research outcome.

Keynote Address 2



*Dr. Yogachandran Rahulamathavan
Loughborough University London,
United Kingdom.*

Yogachandran Rahulamathavan is a Senior Lecturer and the Programme Director for MSc Cyber Security and Data Analytics at Loughborough University's London Campus in the UK. Yoga obtained his PhD degree from Loughborough University in mathematical optimisation techniques for information processing in 2012. His research interest is on developing novel security protocols to advance machine learning techniques to solve complex privacy issues. Currently focussing on post-quantum encryption techniques to develop privacy-preserving machine learning algorithms. Currently, Dr Rahul coordinates a UK-India project between Loughborough University London, IIT Kharagpur, India and City, University of London. He is a Senior Member of IEEE and an Associate Editor for the IEEE Access journal.

Keynote Title: "Hide-And-Seek: Machine Learning in Encrypted Domain"

Abstract

Machine Learning models were built using a huge amount of high-quality and application-specific data. Even though the machine learning models can only be trained at places where the data is available, anyone can use the trained model for classification tasks via the Internet. While it sounds revolutionary, the trained ML models are not readily available to users in healthcare, finance, or marketing due to privacy issues. Users do not want to share their sensitive data with service providers due to a lack of trust. Simply encrypting the data only protects them during storage and transmission. Researchers and industries are developing novel techniques known as privacy-preserving techniques to process the data in an encrypted domain to tackle the privacy issue. Homomorphic encryption plays a key role in developing privacy-preserving machine learning algorithms. While homomorphic properties exist in traditional cryptographic schemes such as RSA, this talk will focus on fully homomorphic encryption from lattice-based cryptography. We will also go through the state-of-the-art works, challenges and future trend in this domain.

Keynote Address 3



*Dr. Sadeep Jayasumana
Senior Research Scientist at Google Research,
New York.*

Sadeep Jayasumana is a Senior Research Scientist at Google Research, New York. His research interests are in the areas of computer vision, deep learning, and machine learning in general. Before joining Google, Sadeep has held research positions at Five AI, a UK-based self-driving car startup, and Man AHL, a London-based quantitative hedge fund. During his time in academia, Sadeep completed a Postdoc at the University of Oxford, and a PhD at the Australian National University - both in computer vision. He obtained his undergraduate degree from the Department of Electronic and Telecommunication Engineering, University of Moratuwa.

Keynote Title: "Advances in Deep Learning"

Abstract

Deep learning has become the key machine learning tool in various AI application areas such as computer vision, natural language processing, and speech recognition. Systems powered by deep learning are already in everyday use; examples are: image and voice recognition software on smartphones, recommendation systems on eCommerce websites, and language translation software. Even more exciting deep-learning-powered systems like self-driving cars are just around the corner.

Keynote Address 4



*Professor Sunny Joseph Kalayathankal
Jyothi Engineering College, Thrissur, Kerala,
India.*

Prof. Sunny Joseph Kalayathankal received the MSc. degree from Kerala University, Kerala, India in 1986, BEd from Calicut University, Kerala in 1987, MPhil Kerala University in 1993 and Ph.D (Mathematics) degree in 2010 from Kerala University, MCA from Indira Gandhi National Open University, New Delhi, India in 2002, M.Tech IT from Karnataka State Open University in 2013 and Ph.D. in Computer Science under Bharathiar University, Coimbatore, India in 2018. He is currently working as a Principal (Professor and Dean of Research) Jyothi Engineering College Affiliated to APJ Abdul Kalam Technological University, Thrissur, Kerala India and has 34 years and 8 months of teaching and 16 years of research experience. He has published more than 84 papers in the areas of Fuzzy modelling and decision making, Graph theory and Applied Mathematics. He has served as Keynote and invited speaker in various National and International conferences. He is the reviewer of Iranian Journal of Fuzzy System, International Journal of Fuzzy system and Journal of Mathematical Modeling and Computer Simulation.

Keynote Title: "Fuzzy Modeling and Decision-Making Applications in Engineering Science"

Abstract

The thought process involved in the act of decision making is a complex array of streaming possibilities in which a person selects or discards information made available from diverse sources. In doing so one is led by a meaningful analysis of available information and optimal selection out of several apparently equi-efficient decisions. Since Zadeh (1965) published the fuzzy set theory as an extension of classic set theory, it has been widely used in many fields of application, such as pattern recognition, data analysis, system control, etc. The unique characteristic of this theory, in contrast to classic mathematics, is its operation on various membership functions (MF) instead of the crisp real values of the variables. Molodtsov (1999) initiated the concept of soft set theory as a new mathematical tool for dealing with uncertainties. Pabitra Kumar Maji et al. (2001) introduced fuzzy soft set theory which also deals with uncertainties.

Out of the several higher order fuzzy sets, intuitionistic fuzzy sets by Atanassov (1985) and Ordered intuitionistic fuzzy sets proposed by Kalayathanal et al. (2010) have been found to be highly useful to deal with vagueness. Intuitionistic fuzzy set is described by

two functions: a membership function and a non - membership function. We develop and apply similarity measures between ordered intuitionistic fuzzy sets to multiple attribute decision making (MADM) under fuzzy environment

Invited Speech



*Mr. Rohan Fernando,
Associate Director, Specialised Solutions,
Acuity Knowledge Partners*

A chartered IT Professional and postgraduate in Enterprise Application Development with over 16 years of experience in enterprise application, data engineering, building analytics platforms, designing, programming and implementing applications (especially in Microsoft.NET technologies, such as .NET 4.0 framework, C#, ASP.NET, AJAX, WCF, WF, WPF and parallel computing with CUDA), Python, QlikView, SSRS-based enterprise reporting solutions, workflow-based applications and SharePoint-based content management and collaboration portals.

Currently working as Associate Director at Acuity Knowledge Partners, Rohan manages the company's data engineering and technology team.

Prior to joining Acuity, Rohan worked at Virtursa as a Senior Software Engineer. A member of British Computer Society, Rohan holds a Master of Science (Enterprise Application Development) from Sheffield Hallam University, UK, and a Bachelor of Science in Information Technology from Middlesex University, UK.

Title: "Rise of Machines in Capital Markets"

Programme Agenda