

Lecture Notes in Electrical Engineering 840

Sagaya Aurelia
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Karthikeyan Subramanian
Saroj Kr. Biswas *Editors*

Sustainable Advanced Computing

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A True leader has the confidence to stand alone, the courage to make tough decisions, and the compassion to listen to the needs of others. He does not set out to be a leader, but becomes one by the equality of his actions and the integrity of his intent.

— *Dauglas Me Arthur*

This book is dedicated to such a leader Dr. Joy Paulose who serves as Head of the Department, Department of Computer Science for his compelling vision, a comprehensive plan and relentless implementation.

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Preface

Welcome to ICSAC2021, the 3rd International Conference on Sustainable Advanced Computing hosted by Departments of Computer Science and Statistics, CHRIST (Deemed to be University), Bangalore Central Campus, Bangalore co-hosted by ACM students Chapter and Computer Society of India. The conference is mostly held every two years. ICSAC 2020 was held online, which will be remembered as the first time since its inception due to the COVID-19 outbreak. The conference's theme is "Sustainable Advanced Computing for Current Society," Cloud computing, IoT, Big data, Machine Learning (ML), and Robotics are essential enablers for the latest change in the current society and market. The conferences aim to bridge Indian and overseas researchers, practitioners, and educators, with a particular focus on innovative models, theories, techniques, algorithms, methods, and domain-specific applications and systems, from both technical and social aspects in Sustainable Advanced Computing. The conference provided the participants an opportunity to discuss the recent developments in Computer Science and challenges faced by the community in the 21st century and featured a series of exciting and rich activities, including invited keynotes and technical presentations. We solicited papers on all aspects of research, development, and applications of cloud computing, IoT, Big data, Machine Learning (ML), and Robotics.

We received 347 research articles all over India and from countries like Srilanka, Malaysia, Sultanate of Oman, and the United States of America. To ensure the quality of the conference, we had national and international academic experts and professionals as our reviewers. There were 158 reviewers, out of which 15 were from different countries across the globe. It was a professional and skill-based exercise for the review committee to assign the manuscript to the right reviewers and receive their valuable reviews on time. After thorough scrutiny, 54 papers were selected for presentation and publication. Hence, the acceptance ratio of this conference is 13.87%.

The accepted papers were presented in 8 different sessions, covering major research domains like Artificial Intelligence, Machine learning, Cloud Computing, Data Analytics, Data Security, Networks, BlockChain, Virtual and Augmented reality, and the Internet of Things.

I hope this conference served as a hub and knowledge repository for the researchers to share their latest research ideas! We wish that further editions of ICSAC will reach greater heights in the future.

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Acknowledgements

No one who achieves success does so without acknowledging the help of others. The wise and confident acknowledge this help with gratitude.

–Alfred North Whitehead

On behalf of the International Conference on Sustainable Advanced Computing 2021 committee and the entire fraternity of the institution, I, first of all, extend my most sincere thanks to the Almighty God for giving us strength, knowledge, and good health for conducting this International conference successfully.

I am happy to acknowledge **Dr. Fr. Abraham Vettiyankal Mani**. Our respected Vice-Chancellor, **Rev. Fr. Jose CC**. Pro-vice Chancellor, **Dr. Joseph Varghese**, Director, Center for Research, beloved registrar **Dr. Anil Joseph Pinto**, and all the management authorities for giving us permission and logistic support to conduct this International conference in a hybrid mode which made this event a historical benchmark in the history of CHRIST (Deemed to be University). I also extend my sincere gratitude to our beloved Dean Science **Dr. George Thomas** and Associate Dean Sciences **Dr. T. V. Joseph** for their kind support throughout the conference. I open my wholehearted thanks to **Dr. Joy Paulose**, Organizing Chair and Head of Department, Department of Computer Science, for being the backbone of this entire conference. I will fail from my duty if I don't remember **Mrs. Kamiya Katter** and Mr. Rajaneesh from Springer, without which this publication would not have been possible.

I sincerely recognize **Dr. Bonny Banerjee**, Associate Professor, Institute of Intelligent Systems and Department of Electrical and Computer Engineering, University of Memphis, USA, for delivering a thought-provoking talk during the inaugural ceremony of the conference. Special recognition to **Dr. Balasubramanian**, Vice-president of Software Engineering, Corporate, and Investment bank, Singapore, for accepting our invitation and gracing the occasion with his enlightened speech for the valedictory function.

I humbly acknowledge all the eminent keynote speakers in various domains of Computer Science. **Dr. S. S. Iyengar**, Professor from Florida International University, USA, **Dr. Subhrabrata Choudhury**, Professor, National Institute of Technology, WB. **Dr. Dilip Kumar Yadav**, Professor from National Institute of Technology, Jamshedpur. **Prof Sheikh Iqbal Ahamed** from Marquette University, USA. **Dr. Saiyed Younus**, University of Kalamoon, Syria. **Dr. Somashekhar Hiremath**, IIT, Chennai, and **Dr. Saroj Biswas** from the National Institute of Technology, Silchar.

I also appreciate and acknowledge the session chair, **Dr. Vishwanathan**, from VIT Chennai. **Dr. Rajeev Mente** from Solapur University, **Dr. Jayapandian** from Christ University Kengeri Campus, Dr. Prasanna, VIT Vellore, Dr. Ravindra Hegade, Central University of Karnataka, **Dr. Seetha Lakshmi**, SRM Chennai, and **Dr. Uma Rani**, SRM, Chennai. I also acknowledge all the external and internal reviewers for providing their helpful comments and improving the quality of papers presented in the forum.

My sincere gratitude to **Fr. Justin Varghese**, Director, IT supports, and all IT support staff members, student volunteers, and non-teaching staff for their support throughout the conference who worked day and night to make this event a grand success. I thank all the advisory committee members, coordinators, committee heads and members, faculties of Computer Science and Statistics Departments. Their names are listed below.

I acknowledge all the authors who submitted papers and congratulate those whose papers were accepted with a deep sense of appreciation.

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