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33rd International Scientific Conference

CECIIS

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University of Zagreb

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Preface

It is our great honour to present to you the Proceedings of the Central European Conference on Information and Intelligent Systems 2022. We hope that you will find it useful, exciting and inspiring.

These Proceedings contain full text conference papers presented at the annual international Central European Conference on Information and Intelligent Systems (CECIIS), organized by the Faculty of Organization and Informatics Varaždin, Croatia and hosted by the University of Dubrovnik, in Dubrovnik, on September 21-23, 2022.

CECIIS has been held for 33 years with the aim to be the interface between researchers and professionals within the field of information and intelligent systems and related areas and the official language of the Conference is English.

The special topic of CECIIS 2022 Conference – "Smart Industry in post Covid-19 society", was designed to provide our participants with an opportunity to research and discuss the possibilities and challenges of new industrial and social changes brought by Covid-19 pandemic. Smart industry is a very important topic since it brings new momentum to the troubled economies that face many challenges. We are building a new generation of enterprises that will be future ready, resilient and capable of utilizing advanced technologies including robotics and artificial intelligence. In that process, interdisciplinarity is the key to success. We must creatively combine technology, management, business processes, business models, digital ecosystems, regulatory framework and many other aspects. At the same time, there is a rising fear that certain part of the population will be left behind and that all these advancements will create a deep social divide. These issues must be considered and analysed by the scientific community and that is why events like CECIIS are important for the open exchange of opinions and ideas. It is our ambition to gather critical thinkers who can contribute to the challenges of the present. We also would like to mention that the convergence of Program and Organizing Committee members, academics and experts of different industries allows us to create a cross-disciplinary approach of the conference, moving on the future topics that will be trending very soon, but also the possibility of facilitating networking between people with different areas of expertise. Bringing together thought members from 13 different countries and 30 different institutions and sectors to share their views on driving change in a new era of global connectivity gives added value to CECIIS.

The Proceedings of CECIIS 2022 include 57 scientific papers, peer-reviewed by at least two independent reviewers and accepted by the international Program Committee, within the following sections: Computer Games, Data and Knowledge Bases, Digital Response to Pandemic, Digital Transformation and Corporate Culture, Education and Learning Analytics, ICT Entrepreneurship and Innovation, Intelligent Energy, Intelligent Systems, Quality in ICT, Strategic Planning and Decision Making, Systems for Smart Mobility and Trends in Software Engineering. The papers were accepted for publication based on their interest, relevance, innovation and application to the information and intelligent systems.

The review process has been conducted with the dedication of 106 reviewers (42 reviewers from Croatia and 64 from abroad) who conducted 191 reviews which resulted with 57 accepted papers. The papers were prepared by 153 authors from 15 countries and presented during the conference. After the conference, a number of selected papers will be further reviewed with the possibility of being extended and published within the Journal of Organizational and Information Sciences (JIOS), the international scientific journal published by the Faculty of Organization and Informatics or within the European Journal of Open, Distance and E-Learning (EURODL).

The special value of this year's conference is featured by the outstanding invited keynote speakers who have left a deep mark in the scientific and professional areas of their interest. We are happy that we gathered such prominent speakers to highlight our conference. Within CECIIS 2022, the following invited keynote speakers presented their work:

- Professor Nenad Medvidović, Ph.D.: "Software Archipelagos as Impediments to Scientific Progress "- Professor Medvidović is a Director Emeritus of the Center for Systems and Software Engineering and is a Professor in the Computer Science Department at the University of Southern California. He is a faculty associate of the Institute for Software Research (ISR) at the University of California, Irvine. Medvidovic is a recipient of the National Science Foundation CAREER (2000) and ITR (2003) awards, as well as the

Okawa Foundation Research Grant (2005), IBM Real-Time Initiative Faculty Award (2007), Orange County Engineering Council's Distinguished Engineering Merit Award (2018), and ACM SIGSOFT's Distinguished Service Award (2020).

- Professor Ozan Tonguz, Ph.D.: "Pervasive use of AI and Machine Learning in Smart Transportation" - Professor Tonguz is a Full Professor in the Electrical and Computer Engineering Department of Carnegie Mellon University (CMU), Founder and CEO of Virtual Traffic Lights, LLC, and Co-Founder, CEO of Reflex AI and a pioneer in vehicular communications, V2X, wireless communications, and biologically inspired design. His work has been funded by several agencies including NSF, DARPA, US DoT, ABB, Harris RF Communications, Intel, General Motors (for 14 years), Texas Instruments, NeuroKinetics, and the Public Investment Fund (PIF) of Saudi Arabia. His current research is focused on AI and Machine Learning (ML), wireless communications, V2V and V2X communications, Computer Vision, and Autonomous Driving. Professor Tonguz has 30 US patents and is the author or co-author of more than 300 technical papers in the IEEE and ACM journals and conferences.

This year's conference featured two poster sections and gathered 12 scientific research posters and 11 student posters. The posters were prepared by 67 authors from 11 countries and presented during the conference.

The conference program also included a panel discussion "Smart University for Smart Industry" moderated by professor Blaženka Divjak, PhD (Faculty of Organization and Informatics, University of Zagreb, Croatia). The panelists were invited to share their visions of smart universities. They also discussed the position of smart universities in relation to industry in terms of new, AI-related technologies, as well as opportunities, benefits and challenges, and the contribution of smart universities to the society and industry.

We would like to thank all participants for their contributions to the Conference program and these Proceedings. Our special thanks goes to the invited speakers, authors, reviewers, session chairs, as well as Program and Organizing Committee members for their time and effort. The organizational and supporting assistance of the Faculty of Organization and Informatics was crucial for the overall success of the conference.
Finally, we are especially grateful to all our academic and industrial partners and sponsors for their support. CECIIS 2022 was organized in partnership with the EDEN Digital Learning Europe, Faculty of Transport and Traffic Sciences of the University of Zagreb, Faculty of Electrical Engineering and Computing of the University of Zagreb, Faculty of Electrical Engineering, Computer Science and Information Technology Osijek and the University of Dubrovnik.
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Finally, it is our wish that all the participants of CECIIS 2022 had a wonderful and fruitful time at the conference and find relevant and interesting papers in the following pages. We are extremely proud that many CECIIS participants have become our friends during all these years and that CECIIS has a circle of dedicated participants that confirm to us that every effort to make the conference better is worth it.

We are looking forward to the following Central European Conference on Information and Intelligent Systems to be held in autumn 2023.

September, 2022

On the behalf of the Program and Organizing Committees

Neven Vrček, Lourdes Guàrdia and Petra Grd
Editors

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