

Lecture Notes of the Institute for Computer Sciences, Social Informatics and Telecommunications Engineering

311

Editorial Board Members

Ozgur Akan

Middle East Technical University, Ankara, Turkey

Paolo Bellavista

University of Bologna, Bologna, Italy

Jiannong Cao

Hong Kong Polytechnic University, Hong Kong, China

Geoffrey Coulson

Lancaster University, Lancaster, UK

Falko Dressler

University of Erlangen, Erlangen, Germany

Domenico Ferrari

Università Cattolica Piacenza, Piacenza, Italy

Mario Gerla

UCLA, Los Angeles, USA

Hisashi Kobayashi

Princeton University, Princeton, USA

Sergio Palazzo

University of Catania, Catania, Italy

Sartaj Sahni

University of Florida, Gainesville, USA

Xuemin (Sherman) Shen

University of Waterloo, Waterloo, Canada

Mircea Stan

University of Virginia, Charlottesville, USA

Xiaohua Jia

City University of Hong Kong, Kowloon, Hong Kong

Albert Y. Zomaya

University of Sydney, Sydney, Australia

More information about this series at <http://www.springer.com/series/8197>

Rafik Zitouni · Max Agueh ·
Pélagie Houngue · Hénoc Soude (Eds.)

e-Infrastructure and e-Services for Developing Countries

11th EAI International Conference, AFRICOMM 2019
Porto-Novo, Benin, December 3–4, 2019
Proceedings

Editors

Rafik Zitouni 
ECE Paris Graduate School of Engineering
Paris, France

Max Agueh
EFREI Paris
Paris, France

Pélagie Houngue
Institut de Mathématiques et de Sciences
Physiques (IMSP)
Porto-Novo, Benin

Hénoc Soude
Institut de Mathématiques et de Sciences
Physiques (IMSP)
Porto-Novo, Benin

ISSN 1867-8211 ISSN 1867-822X (electronic)
Lecture Notes of the Institute for Computer Sciences, Social Informatics
and Telecommunications Engineering
ISBN 978-3-030-41592-1 ISBN 978-3-030-41593-8 (eBook)
<https://doi.org/10.1007/978-3-030-41593-8>

© ICST Institute for Computer Sciences, Social Informatics and Telecommunications Engineering 2020
This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

We are delighted to introduce the proceedings of the 11th edition of the 2019 European Alliance for Innovation (EAI) International Conference on e-Infrastructure and e-Services for Developing Countries (AFRICOMM 2019). This conference has brought together researchers, developers, and practitioners who are leveraging and developing new technologies such as cloud computing, IoT, data analytics, green computing, etc. in developing countries. Deploying efficient and effective infrastructures and solutions when limited resources are available is a challenging task and a key-enabler for the diffusion of Information and Communication Technologies (ICT) in developing countries. The aim of this conference is to bring together international researchers, students, engineers, policy makers, and practitioners in ICT to discuss issues and trends, recent research, innovation advances, and on-the-field experiences related to e-Governance, e-Infrastructure, and e-Business with a focus on developing countries.

The technical program of AFRICOMM 2019 received 49 submissions, including full and short papers. 18 papers were accepted as full papers. Authors were from different countries including Benin, Tunisia, South Africa, Senegal, Italy, Burkina Faso, Ivory Coast, Germany, Namibia, etc. Some contributions were also joint between several institutions and countries.

The accepted papers cover several topics related to emerging technologies and their use in developing countries in particular, and in rural areas in general. These topics span different infrastructures, technologies and paradigms, and application fields. Examples include targeted infrastructures, Internet of Things (IoT), Wireless and Mobile Networks, Intelligent Transportation Systems (ITS), Software and Network Security, Cloud and Virtualization, Data Analytics, Machine Learning, etc. The conference tracks were as follows: Track 1 – Software and Network Security; Track 2 – Smart Cities; Track 3 – Internet of Things (IoT); and Track 4 – Data Management and IT Applications. Aside from the high-quality technical paper presentations, the technical program also featured two keynote speeches and an AFRICATEK workshop. The two keynote speakers were Mr. Pierre Dandjinou Ican (Vice President of Stakeholder Engagement in Africa, Benin) and Mr. Colombiano Kedowide (Consultant and IT expert, Canada). The AFRICATEK workshop focused on African's personal data security issues and on an Artificial Intelligence (AI) based prediction system, which improves student academic performances.

Coordination with the steering chairs was essential for the success of the conference. We sincerely appreciated their constant support and guidance. It was also a great pleasure to work with such an excellent Organizing Committee and we thank the team for their hard work in organizing and supporting the conference. In particular, the Technical Program Committee (TPC), led by our TPC Co-Chairs, Dr. Pélagie Houngue and Dr. Henoc Soude, completed the peer-review process of technical papers and made a high-quality technical program. We are also grateful to conference manager,

Kristina Lappyova, for her support as well as all the authors who submitted their papers to the AFRICOMM 2019 conference and workshop.

We strongly believe that the AFRICOMM 2019 conference provided a good forum for all researcher, developers, and practitioners to discuss all science and technology aspects that are relevant to smart grids. We also expect that the future AFRICOMM conference will be as successful and stimulating, as indicated by the contributions presented in this volume.

December 2019

Rafik Zitouni
Max Agueh
Pélagie Houngue
Hénoc Soude

Organization

Steering Committee

Imrich Chlamtac University of Trento, Italy
Max Agueh ESIEE Paris, France

Organizing Committee

General Chair

Max Agueh ESIEE Paris, France

General Co-chairs

Pélagie Houngue IMSP Porto-Novo, Benin
Soude Hénoc IMSP Porto-Novo, Benin

TPC Chair and Co-chairs

Rafik Zitouni ECE Paris, France
Max Agueh ESIEE Paris, France

Local Chairs

Pélagie Houngue IMSP, Université d'Abomey-Calavi, Benin
Hénoc Soude IMSP, Université d'Abomey-Calavi, Benin
Jules Degila IMSP, Université d'Abomey-Calavi, Benin

Workshop Chair

Arnaud Ahouandjinou IFRI, Université d'Abomey-Calavi, Benin

Publications Chair

Rafik Zitouni ECE Paris, France

Posters and PhD Track Chair

Aghiles Djoudi ECE Paris, France

Demos Chair

Stefan Ataman ELI-NP, Romania

Tutorials Chairs

Pierre Courbin ESILV, France
Frederic Fauberteau ESILV, France

Technical Program Committee

Max Agueh	ESIEE Paris, France
Pélagie Houngue	IMSP, Université d'Abomey-Calavi, Benin
Soude Hénoc	IMSP, Université d'Abomey-Calavi, Benin
Rafik Zitouni	ECE Paris, France
Carlyna Bondiombouy	ECE Paris, France
Patrick Valduriez	Inria, France
Muhammad Ijaz	University of Manchester, UK
Bouziane Brik	Eurecom, France
Ahmed Kora	ESMT, Senegal
Marco Zennaro	ICTP, Italy
Eugene C. Ezin	UAC, Benin
Hamid Harroud	Alakhawayn University, Morocco
Christian Attiogbe	Université de Nantes, France
Jonathan Ouoba	VTT, Finland
Karl Jonas	H-BRS, Germany
Kokou Yetongnon	Université de Bourgogne, France
Pierre Courbin	ESILV, France
Stefan Ataman	ELI-NP, Romania
Idris Rai	University of Zanzibar, Tanzania
Tayeb Lemlouma	IRISA, France
Benaoumeur Senouci	ECE Paris, France
Frédéric Fauberteau	ESILV, France
Taha Ridene	RTIT, France
Sihem Zitouni	Université de Bejaïa, Algeria
Hakim Badis	Université Paris Est, France
Joel Hounsou	IMSP, Université d'Abomey-Calavi, Benin
Sanda Tidjani	IMSP, Université d'Abomey-Calavi, Benin
Arnaud Ahouandjinou	IFRI, Université d'Abomey-Calavi, Benin
Romaric Sagbo	IMSP, Université d'Abomey-Calavi, Benin
Victor Odumuyiwa	University of Lagos, Nigeria
Aghiles Djoudi	ECE Paris, France
Laurent George	ESIEE Paris, France
Nadir Bouchama	CERIST Research Center, Algeria
Houda Chihi	Sup'Com, Tunisia
Yassine Boufeneche	USTHB, Algeria
Kyung-Hyune Rhee	KIIScN, South Korea
Bo Jing	Baidu Technology, China
Na Inseop	Chosun University, South Korea
Balint Kiss	Budapest University, Hungary

Contents

Software Security

Analysis of the Impact of Permissions on the Vulnerability of Mobile Applications	3
<i>Gouayon Koala, Didier Bassolé, Aminata Zerbo/Sabané, Tegawendé F. Bissyandé, and Oumarou Sié</i>	
On the Relevance of Using Multi-layered Security in the Opportunistic Internet-of-Things	15
<i>Antoine Bagula, Lutando Ngaqwazai, Claude Lubamba Kakoko, and Olasupo Ajayi</i>	
Analysis of Software Vulnerabilities Using Machine Learning Techniques . . .	30
<i>Doffou Jerome Diako, Odilon Yapo M. Achiepo, and Edoete Patrice Mensah</i>	
Africa's Multilateral Legal Framework on Personal Data Security: What Prospects for the Digital Environment?	38
<i>Rogers Alunge</i>	
Proof of Concept of Blockchain Integration in P2P Lending for Developing Countries	59
<i>Fatou Ndiaye Mbodji, Gervais Mendy, Ahmath Bamba Mbacke, and Samuel Ouya</i>	

Smart Cities

A LoRaWAN Coverage Testbed and a Multi-optional Communication Architecture for Smart City Feasibility in Developing Countries	73
<i>Pape Abdoulaye Barro, Marco Zennaro, and Jules Degila</i>	
Effective Management of Delays at Road Intersections Using Smart Traffic Light System	84
<i>Olasupo Ajayi, Antoine Bagula, Omowunmi Isafiade, and Ayodele Noutouglo</i>	
Binary Search Based PSO for Master Node Enumeration and Placement in a Smart Water Metering Network	104
<i>Clement N. Nyirenda and Samson G. Nyirongo</i>	

Internet of Things

State of Internet Measurement in Africa - A Survey 121
*Musab Isah, Amreesh Phokeer, Josiah Chavula, Ahmed Elmokashfi,
and Alemnew Sheferaw Asrese*

I2PA, U-prove, and Idemix: An Evaluation of Memory Usage
and Computing Time Efficiency in an IoT Context 140
Ibou Sene, Abdoul Aziz Ciss, and Oumar Niang

A Hybrid Network Model Embracing NB-IoT and D2D Communications:
Stochastic Geometry Analysis. 154
*Athanase M. Atchome, Hafiz Husnain Raza Sherazi, Rodrigue Alahassa,
Frantz Tossa, Thierry O. Edoh, Luigi Alfredo Grieco,
and Antoine C. Vianou*

Data Management and IT Applications

Laws and Regulations on Big Data Management: The Case of South Africa . . . 169
Patrick Sello, Antoine Bagula, and Olasupo Ajayi

Big Data Processing Using Hadoop and Spark:
The Case of Meteorology Data 180
*Eslam Hussein, Ronewa Sadiki, Yahlieel Jafta,
Muhammad Mujahid Sungay, Olasupo Ajayi, and Antoine Bagula*

Classification of Plant Species by Similarity Using Automatic Learning. 186
*Zacrada Françoise Odile Trey, Bi Tra Goore,
and Brou Marcellin Konan*

Mobile Health Applications Future Trends and Challenges 202
*Teddy Ivan Ibrahim Bessin, Alain Wilfried P. Ouédraogo,
and Ferdinand Guinko*

AmonAI: A Students Academic Performances Prediction System 212
*Iffanice B. Houndayi, Vinasetan Ratheil Houndji, Pierre Jérôme Zohou,
and Eugène C. Ezin*

Factors Influencing the Adoption of m-Government:
Perspectives from a Namibian Marginalised Community 219
Karin Frohlich, Marko Nieminen, and Antti Pinomaa

Recent Approaches to Drift Effects in Credit Rating Models 237
Rachael Chikoore, Okuthe P. Kogeda, and S. O. Ojo

Author Index 255