

Michael E. Auer · Reinhard Langmann  
Editors

# Smart Industry & Smart Education

Proceedings of the 15th International Conference on Remote Engineering and Virtual Instrumentation



Springer

# Contents

## Internet of Things and Industry 4.0

- A Cloud-Based Blended Learning Lab for PLC Education . . . . .** 3  
Reinhard Langmann and Matthias Coppenrath

- Environmental Sound Recognition with Classical Machine Learning Algorithms . . . . .** 14  
Nikolina Jekic and Andreas Pester

- Early Signs of Diabetes Explored from an Engineering Perspective . . . . .** 22  
Jenny Lundberg and Lena Claesson

- Digitalization of Engineering Education: From E-Learning to Smart Education . . . . .** 32  
Irina Makarova, Ksenia Shubenkova, Dago Antov,  
and Anton Pashkevich

- Investigating Rate Increase in Aerospace Factory By Simulation of Material Flow Operations . . . . .** 42  
Laura Lopez-Davalos, Amer Liaqat, Windo Hutabarat, Divya Tiwari,  
and Ashutosh Tiwari

- Demonstration: Cloud-Based Industrial Control Services . . . . .** 50  
Reinhard Langmann and Leandro Rojas-Peña

- Poster: Teaching Automation and Logistics with Virtual Industrial Process . . . . .** 57  
Florence Lecroq, Jean Grieu, and Hadhoum Boukachour

## Remote Control and Measurements

- Use of VISIR Remote Lab in Secondary School: Didactic Experience and Outcomes . . . . .** 69  
Manuel Blazquez-Merino, Alejandro Macho-Aroca, Pablo Baizán-Álvarez,  
Félix García-Loro, Elio San Cristobal, Gabriel Diez, and Manuel Castro

<b>On Effective Maintenance of Distributed Remote Laboratories . . . . .</b>	80
Tobias Fäth, Karsten Henke, René Hutschenreuter, Felix Seidel, and Heinz-Dietrich Wuttke	
<b>A Multi-agent System for Supervisory Temperature Control Using Fuzzy Logic and Open Platform Communication Data Access . . . . .</b>	90
Martha Kafuko and Tom Wanyama	
<b>Combining Virtual and Remote Interactive Labs and Visual/Textual Programming: The Furuta Pendulum Experience . . . . .</b>	100
Daniel Galan, Luis de la Torre, Dictino Chaos, and Ernesto Aranda	
<b>TRIANGLE Portal: An User-Friendly Web Interface for Remote Experimentation . . . . .</b>	110
Almudena Díaz-Zayas, Alberto Salmerón Moreno, Gustavo García Pascual, and Pedro Merino Gómez	
<b>“Hands-on-Remote” Laboratories . . . . .</b>	118
Frantisek Lustig, Pavel Brom, Pavel Kuriscak, and Jiri Dvorak	
<b>Virtual Power-Line Communications Laboratory for Technology Development and Research . . . . .</b>	128
Asier Llano Palacios, Xabier Osorio Barañano, David de la Vega Moreno, Itziar Angulo Pita, and Txetxu Arzuaga Canals	
<b>Development of an Automatic Assessment in Remote Experimentation Over Remote Laboratory . . . . .</b>	136
Abderrahmane Adda Benattia, Abdelhalim Benachenhou, and Mohammed Moussa	
<b>Demonstration: Using Remotely Controlled One-Way Flow Control Valve for Speed Regulation of Pneumatic Cylinder . . . . .</b>	144
Brajan Bajčić, Slobodan Dudić, Jovan Šulc, Vule Reljić, Dragan Šešlija, and Ivana Milenković	
<b>Demonstration: Virtual Lab for Analog Electronic Circuits . . . . .</b>	153
K. C. Narasimhamurthy, Ankit Sharma, Shorya Shubham, and H. R. Chandan	
<b>Poster: Wireless Sensor Network to Predict Black Sigatoka in Banana Cultivations . . . . .</b>	159
Andrés Subert-Semanat	
<b>Poster: Influence of the Direction of Movement of Earth-Moving and Construction Machines on the Stability of Remote Control Data Transmission via Mobile Communication Channels . . . . .</b>	165
Tatyana Golubeva, Sergey Konshin, Sergey Leshchев, Natalia Mironova, and Boris Tshukin	

**Virtual and Remote Laboratories****Development and Implementation of Remote Laboratory as an Innovative Tool for Practicing Low-Power Digital Design**

- Concepts and Its Impact on Student Learning** ..... 175  
Shatha AbuShanab, Marco Winzker, and Rainer Brück

**Remote Labs for Electrical Power Transmission Lines**

- Simulation Unit** ..... 186  
Kalyan B. Ram, Panchaksharayya S. Hiremath, M. S. Prajval, B. Karthick,  
Prasanth Sai Meda, M. B. Vijayalakshmi, and Priyanka Paliwal

**Sustainability of the Remote Laboratories Based on Systems**

- with Limited Resources** ..... 197  
Galyna Tabunshchyk, Tetiana Kapliienko, and Peter Arras

**What Are Teachers' Requirements for Remote Learning Formats?**

- Data Analysis of an E-Learning Recommendation System** ..... 207  
Thorsten Sommer, Valerie Stehling, Max Haberstroh, and Frank Hees

**Evaluating Remote Experiment from a Divergent Thinking Point**

- of View** ..... 217  
Cornel Samoila, Doru Ursutiu, and C. A. Neagu

**“Electromagnetic Remote Laboratory” with Embedded**

- Simulation and Diagnostics** ..... 226  
Franz Schauer, Michal Gerza, Michal Krbecek, Das Sayan,  
Mbuotidem Ime Archibong, and Miroslava Ozvoldova

**Smart Grid Remote Laboratory** ..... 234

- Kalyan B. Ram, S. Arun Kumar, Manish Ahlawat,  
Sanjoy Kumar Parida, S. Prathap, Preeti S. Biradar, and Vishnu Das

**e-LIVES – Extending e-Engineering Along the South**

- and Eastern Mediterranean Basin** ..... 244  
Manuel Gericota, Paulo Ferreira, André Fidalgo, Guillaume Andrieu,  
Abdallah Al-Zoubi, Majd Batarseh, and Danilo Garbi-Zutin

**A Reliability Assessment Model for Online Laboratories Systems** ..... 252

- Luis Felipe Zapata-Rivera and Maria M. Larrondo-Petrie

**Digital Remote Labs Built by the Students and for the Students** ..... 261

- J. Nikhil, J. Pavan, H. O. Darshan, G. Anand Kumar, J. Gaurav,  
and C. R. Yamuna Devi

**Virtual Learning Environment for Digital Signal Processing** ..... 269

- Yadisbel Martinez-Cañete, Sergio Daniel Cano-Ortiz,  
Frank Sanabria-Macias, Reinhard Langmann, Harald Jacques,  
and Pedro Efrain Diaz-Labiste

<b>Online Experimenting with 3D LED Cube . . . . .</b>	277
Katarína Žáková	
<b>Management of Control Algorithms for Remote Experiments . . . . .</b>	283
Matej Rábek and Katarína Žáková	
<b>Demonstration: Web Tool for Designing and Testing of Digital Circuits Within a Remote Laboratory . . . . .</b>	290
Javier Garcia-Zubia, Eneko Cruz, Luis Rodriguez-Gil, Ignacio Angulo, Pablo Orduña, and Unai Hernandez	
<b>Poster: An Experience API Framework to Describe Learning Interactions from On-line Laboratories . . . . .</b>	298
Pedro Paredes Barragán, Miguel Rodriguez-Artacho, Elio San Cristobal, Manuel Castro, and Hamadou Saliah-Hassane	
<b>Poster: Remote Engineering Education Set-Up of Hydraulic Pump and System . . . . .</b>	304
Milos Srecko Nedeljkovic, Novica Jankovic, Djordje Cantrak, Dejan Ilic, and Milan Matijevic	
<b>Poster: “Radiation Remote Laboratory” with Two Level Diagnostics . . . . .</b>	312
Michal Krbecek, Sayan Das, Franz Schauer, Miroslava Ozvoldova, and Frantisek Lustig	
<b>Cyber Physical Systems and Cyber Security</b>	
<b>Enabling Remote PLC Training Using Hardware Models . . . . .</b>	323
Alexander A. Kist, Ananda Maiti, Catherine Hills, Andrew D. Maxwell, Karsten Henke, Heinz-Dietrich Wuttke, and Tobias Fäth	
<b>Towards Data-Driven Cyber Attack Damage and Vulnerability Estimation for Manufacturing Enterprises . . . . .</b>	333
Vinayak Prabhu, John Oyekan, Simon Eng, Lim Eng Woei, and Ashutosh Tiwari	
<b>Practical Security Education on Combination of OT and ICT Using Gamification Method at KOSEN . . . . .</b>	344
Keiichi Yonemura, Ryotaro Komura, Jun Sato, and Masato Matsuoka	
<b>SEPT Learning Factory Framework . . . . .</b>	354
Dan Centea, Mo Elbestawi, Ishwar Singh, and Tom Wanyama	
<b>Remote Structural Health Monitoring for Bridges . . . . .</b>	363
Mohammed Misbah Uddin, Nithin Devang, Abul K. M. Azad, and Veysel Demir	
<b>XOR . . . . .</b>	378
Christoph Vorhauer and Klaus Gebeshuber	

<b>Development Models and Intelligent Algorithms for Improving the Quality of Service and Security of Multi-cloud Platforms . . . . .</b>	386
Irina Bolodurina and Denis Parfenov	
<b>The Application of the Remote Lab for Studying the Issues of Smart House Systems Power Efficiency, Safety and Cybersecurity . . . . .</b>	395
Anzhelika Parkhomenko, Artem Tulenkov, Aleksandr Sokolyanskii, Yaroslav Zalyubovskiy, Andriy Parkhomenko, and Aleksandr Stepanenko	
<b>Human Machine Interaction and Usability</b>	
<b>Human-Computer Interaction in Remote Laboratories with the Leap Motion Controller . . . . .</b>	405
Ian Grout	
<b>Visual Tools for Aiding Remote Control Systems Experiments with Embedded Controllers . . . . .</b>	415
Ananda Maiti, Andrew D. Maxwell, and Alexander A. Kist	
<b>Process Mining Applied to Player Interaction and Decision Taking Analysis in Educational Remote Games . . . . .</b>	425
Thiago Schaedler Uhlmann, Eduardo Alves Portela Santos, and Luciano Antonio Mendes	
<b>An Approach to Teaching Blind Children of Geographic Topics Through Applying a Combined Multimodal User Interfaces . . . . .</b>	435
Dariusz Mikulowski	
<b>Development of a Virtual Environment for Environmental Monitoring Education . . . . .</b>	443
Jeremy Dylan Smith and Vinod K. Lohani	
<b>School Without Walls - An Open Environment for the Achievement of Innovative Learning Loop . . . . .</b>	451
Carole Salis, Marie Florence Wilson, Franco Atzori, Stefano Leone Monni, Fabrizio Murgia, and Giuliana Brunetti	
<b>Low-Cost, Open-Source Automation System for Education, with Node-RED and Raspberry Pi . . . . .</b>	458
Phaedra Degreef, Dirk Van Merode, and Galyna Tabunshchyk	
<b>Demonstration: Face Emotion Recognition (FER) with Deep Learning – Web Based Interface . . . . .</b>	466
Andreas Pester and Kevin Galler	
<b>Poster: An Approach for Supporting of Navigation of Blind People in Public Building Based on Hierarchical Map Ontology . . . . .</b>	471
Dariusz Mikulowski and Marek Pilski	

<b>Poster: A Mobile Application for Voice and Remote Control of Programmable Instruments . . . . .</b>	479
Burak Ece, Ayse Yayla, and Hayriye Korkmaz	
<b>Biomedical Engineering</b>	
<b>Organic Compounds Integrated on Nanostructured Materials for Biomedical Applications . . . . .</b>	489
Cristian Ravariu, Elena Manea, Florin Babarada, Doru Ursutiu, Dan Mihaiescu, and Alina Popescu	
<b>Towards an Automated Analysis of Forearm Thermal Images During Handgrip Exercise . . . . .</b>	498
Pedro Silva, Ricardo Vardasca, Joaquim Mendes, and Maria Teresa Restivo	
<b>Handgrip Evaluation: Endurance and Handedness Dominance . . . . .</b>	507
Ricardo Vardasca, Paulo Abreu, Joaquim Mendes, and Maria Teresa Restivo	
<b>Digital Health for Computer Engineering Classes: An Experience . . . . .</b>	517
Lucia Vaira and Mario A. Bochicchio	
<b>A Support System for Information Management Oriented for the Infant Neurodevelopment Study . . . . .</b>	528
Sergio Daniel Cano-Ortiz, Yadisbel Martinez-Cañete, Lienys Lombardía-Legrá, Reinhard Langmann, and Harald Jacques	
<b>Demonstration: Online Detection of Abnormalities in Blood Pressure Waveform: Bisfiriens and Alternans Pulse . . . . .</b>	536
Daniel Nogueira, Rafael Tavares, Paulo Abreu, and Maria Teresa Restivo	
<b>Augmented and Mixed Reality</b>	
<b>The Effect of Augmented Reality in Solid Geometry Class on Students' Learning Performance and Attitudes . . . . .</b>	549
Enrui Liu, Yutan Li, Su Cai, and Xiaowen Li	
<b>Multimodal Data Representation Models for Virtual, Remote, and Mixed Laboratories Development . . . . .</b>	559
Yevgeniya Sulema, Ivan Dychka, and Olga Sulema	
<b>Voice Driven Virtual Assistant Tutor in Virtual Reality for Electronic Engineering Remote Laboratories . . . . .</b>	570
Michael James Callaghan, Gildas Bengloan, Julien Ferrer, Léo Cherel, Mohamed Ali El Mostadi, Augusto Gomez Eguíluz, and Niall McShane	

<b>Using Unity 3D as the Augmented Reality Framework for Remote Access Laboratories . . . . .</b>	581
Mark Smith, Ananda Maiti, Andrew D. Maxwell, and Alexander A. Kist	
<b>A Literature Review on Collaboration in Mixed Reality . . . . .</b>	591
Philipp Ladwig and Christian Geiger	
<b>REMLABNET and Virtual Reality . . . . .</b>	601
Tomas Komenda and Franz Schauer	
<b>Exposing Robot Learning to Students in Augmented Reality Experience . . . . .</b>	610
Igor Verner, Michael Reitman, Dan Cuperman, Toria Yan, Eldad Finkelstein, and Tal Romm	
<b>Framework for Augmented Reality Scenarios in Engineering Education . . . . .</b>	620
Matthias Neges, Mario Wolf, Robert Kuska, and Sulamith Frerich	
<b>Poster: SIMNET: Simulation-Based Exercises for Computer Network Curriculum Through Gamification and Augmented Reality . . .</b>	627
Alvaro Luis Fraga, Maria Guadalupe Gramajo, Federico Trejo, Selena Garcia, Gustavo Juarez, and Leonardo Franco	
<b>Applications and Experiences</b>	
<b>Using Learning Theory for Assessing Effectiveness of Laboratory Education Delivered via a Web-Based Platform . . . . .</b>	639
Shyam Diwakar, Rakhi Radhamani, Nijin Nizar, Dhanush Kumar, Bipin Nair, and Krishnashree Achuthan	
<b>Vocational Education for the Industrial Revolution . . . . .</b>	649
Enrique Blanco, Fernando Schirmbeck, and Claiton Costa	
<b>Students' Perception of E-library System at Fujairah University . . . . .</b>	659
Ahmad Qasim Mohammad AlHamad and Roqayah Abdulraheim AlHammadi	
<b>Virtual Working Environment Scheduling of the Cloud System for Collective Access to Educational Resources . . . . .</b>	671
Irina Bolodurina, Leonid Legashev, Petr Polezhaev, Alexander Shukhman, and Yuri Ushakov	
<b>Activities of Euro-CASE Engineering Education Platform . . . . .</b>	678
Petar Bogoljub Petrovic and Milos Srecko Nedeljkovic	

<b>Virtual Instrumentation Used in Engineering Education Set-Up of Hydraulic Pump and System . . . . .</b>	686
Milos Srecko Nedeljkovic, Djordje Cantrak, Novica Jankovic, Dejan Ilic, and Milan Matijevic	
<b>Study of Remote Lab Growth to Facilitate Smart Education in Indian Academia . . . . .</b>	694
Venkata Vivek Gowripeddi, Kalyan Ram Bhimavaram, J. Pavan, Nithin Janardhan, Amrutha Desai, Shubham Mohapatra, Apurva Shrikhar, and C. R. Yamuna Devi	
<b>Ant Colony Algorithm for Building of Virtual Machine Disk Images Within Cloud Systems . . . . .</b>	701
Irina Bolodurina, Leonid Legashev, Petr Polezhaev, Alexander Shukhman, and Yuri Ushakov	
<b>Work in Progress: Pocket Labs in IoT Education . . . . .</b>	707
Christian Madritsch, Thomas Klinger, and Andreas Pester	
<b>Demonstration: Using IPython to Demonstrate the Usage of Remote Labs in Engineering Courses – A Case Study Using a Remote Rain Gauge . . . . .</b>	714
Alberto Cardoso, Joaquim Leitão, Paulo Gil, Alfeu S. Marques, and Nuno E. Simões	
<b>Poster: LabSocket-E, LabVIEW and myRIO in Real-Time/Embedded Systems Student Teaching and Training . . . . .</b>	721
Doru Ursutiu, Andrei Neagu, and Cornel Samoilă	
<b>Poster: Smart Applications for Raising Awareness of Young Citizens Towards Using Renewable Energy Sources and Increasing Energy Efficiency in the Local Community . . . . .</b>	728
Radojka Krneta, Snežana Dragićević, Andreas Pester, and Andreja Rojko	
<b>Author Index . . . . .</b>	737