

# **2021 IEEE International Conference on Pervasive Computing and Communications Workshops and other Affiliated Events (PerCom Workshops 2021)**

**Kassel, Germany  
22 – 26 March 2021**



**IEEE Catalog Number: CFP21344-POD  
ISBN: 978-1-6654-4724-9**

**Copyright © 2021 by the Institute of Electrical and Electronics Engineers, Inc.  
All Rights Reserved**

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

***\*\*\* This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP21344-POD
ISBN (Print-On-Demand):	978-1-6654-4724-9
ISBN (Online):	978-1-6654-0424-2

**Additional Copies of This Publication Are Available From:**

Curran Associates, Inc  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: (845) 758-0400  
Fax: (845) 758-2633  
E-mail: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

# TABLE OF CONTENTS

KEYNOTE: EXPLAINABLE AI IN PERVASIVE HEALTHCARE: OPEN CHALLENGES AND RESEARCH DIRECTIONS .....	1
<i>Daniele Riboni</i>	
COMBINING PUBLIC MACHINE LEARNING MODELS BY USING WORD EMBEDDING FOR HUMAN ACTIVITY RECOGNITION .....	2
<i>Koichi Shimoda, Akihito Taya, Yoshito Tobe</i>	
DATA AUGMENTATION STRATEGIES FOR HUMAN ACTIVITY DATA USING GENERATIVE ADVERSARIAL NEURAL NETWORKS.....	8
<i>Alexander Hoelzemann, Nimish Sorathiya, Kristof Van Laerhoven</i>	
IMAGE-BASED ACTIVITY RECOGNITION FROM IMU DATA.....	14
<i>Alejandro Sanchez Guinea, Mehran Sarabchian, Max Mühlhäuser</i>	
TAP: A TRANSFORMER BASED ACTIVITY PREDICTION EXPLOITING TEMPORAL RELATIONS IN COLLABORATIVE TASKS.....	20
<i>Hyunju Kim, Dongman Lee</i>	
COMBINING SYMBOLIC AND STATISTICAL KNOWLEDGE FOR GOAL RECOGNITION IN SMART HOME ENVIRONMENTS .....	26
<i>Nils Wilken, Heiner Stuckenschmidt</i>	
EXPLAINABLE ACTIVITY RECOGNITION OVER INTERPRETABLE MODELS.....	32
<i>Claudio Bettini, Gabriele Civitaresse, Michele Fiori</i>	
A METHOD FOR ESTIMATING DOCTOR'S FATIGUE LEVEL IN OPERATING A SURGICAL ROBOT USING WEARABLE SENSORS .....	38
<i>Ayumi Ohnishi, Hayate Tohnan, Tsutomu Terada, Minoru Hattori, Hisaaki Yoshinaka, Yusuke Sumi, Hiroyuki Egi, Masahiko Tsukamoto</i>	
DEVELOPING A “SENSE OF AGENCY” IN IOT SYSTEMS: PRELIMINARY EXPERIMENTS IN A SMART HOME SCENARIO.....	44
<i>Marco Lippi, Stefano Mariani, Franco Zambonelli</i>	
HYBRID DISTANCE-BASED FRAMEWORK FOR CLASSIFICATION OF EMBEDDED FIREARM RECOIL DATA.....	50
<i>David Welsh, Abu Zaher Md Faridee, Nirmalya Roy</i>	
KEYNOTE: ROBOTRUST: TRUSTWORTHY INTERACTION BETWEEN HUMANS AND ANTHROPOMORPHIC SERVICE ROBOTS.....	56
<i>Ruth Stock-Homburg, Oskar Von Stryk</i>	
INVESTIGATION OF RELATION BETWEEN PHYSIOLOGICAL RESPONSES AND PERSONALITY DURING STRESS RECOVERY .....	57
<i>Bitan Saha, Linda Becker, Jens-Uwe Garbas, Maximilian Oppelt, Andreas Foltyn, Sebastian Hettenkofer, Nadine Lang, Matthias Struck, Nicolas Rohleder, Bhargavi Mahesh</i>	
EFFECT OF FACIAL EXPRESSION CATEGORIES AND CALCULATION METHODS ON AUTOMATIC EMOTION RECOGNITION.....	63
<i>Damien Dupré</i>	

SHARING GEOTAGGED PICTURES FOR AN EMOTION-BASED RECOMMENDER SYSTEM.....	68
<i>Andreas Hitz, Si-Ahmed Naas, Stephan Sigg</i>	
VFEP: 3D GRAPHIC FACE REPRESENTATION BASED ON VOICE-BASED EMOTION RECOGNITION.....	74
<i>Tomoya Suzuki, Akihito Taya, Yoshito Tobe</i>	
KEYNOTE: DESIGNING PERVASIVE ASSISTIVE TECHNOLOGIES WITH REPRESENTATIVE USERS .....	80
<i>Tiago Guerreiro</i>	
THREE-DIMENSIONAL NONVISUAL DIRECTIONAL GUIDANCE FOR PEOPLE WITH VISUAL IMPAIRMENTS.....	81
<i>Seung A Chung, Kyungyeon Lee, Sohyeon Park, Uran Oh</i>	
ACCESSIBILITY OF HEALTHCARE FACILITY FOR PERSONS WITH VISUAL DISABILITY.....	87
<i>Vikas Upadhyay, M. Balakrishnan</i>	
REMOTE USAGE DATA COLLECTION AND ANALYSIS FOR MOBILE ACCESSIBILITY APPLICATIONS.....	93
<i>Dragan Ahmetovic, Cristian Bernareggi, Mattia Ducci, Andrea Gerino, Sergio Mascetti</i>	
CONSIDERING SPATIAL COGNITION OF BLIND TRAVELERS IN UTILIZING AUGMENTED REALITY FOR NAVIGATION.....	99
<i>Paul Ruvolo</i>	
CITYGUIDE: A SEAMLESS INDOOR-OUTDOOR WAYFINDING SYSTEM FOR PEOPLE WITH VISION IMPAIRMENTS.....	105
<i>Seyed Ali Cheraghi, Vinod Namboodiri, Güler Aarsal</i>	
PATHLOOKUP: A DEEP LEARNING-BASED FRAMEWORK TO ASSIST VISUALLY IMPAIRED IN OUTDOOR WAYFINDING .....	111
<i>Uddipan Das, Vinod Namboodiri, Hongsheng He</i>	
FINDING YOUR WAY BACK: COMPARING PATH ODOMETRY ALGORITHMS FOR ASSISTED RETURN .....	117
<i>Chia Hsuan Tsai, Peng Ren, Fatemeh Elyasi, Roberto Manduchi</i>	
STORM OPERATION PREDICTION: MODELING THE OCCURRENCE OF STORM OPERATIONS FOR FIRE STATIONS.....	123
<i>Kevin Pirklbauer, Rainhard Dieter Findling</i>	
ESCAPEWILDFIRE: ASSISTING PEOPLE TO ESCAPE WILDFIRES IN REAL-TIME .....	129
<i>Andreas Kamilaris, Jesper Provoost, Jean-Baptiste Filippi, Chirag Padubidri, Savvas Karatsiolis, Ian Cole, Wouter Couwenbergh, Evi Demetriou</i>	
FLOOD DETECTION USING SEMANTIC SEGMENTATION AND MULTIMODAL DATA FUSION .....	135
<i>Bipendra Basnyat, Nirmalya Roy, Aryya Gangopadhyay</i>	
KEYNOTE: ENABLING SMART CITIES TO BECOME EVEN SMARTER THROUGH DESIGN FOR DISABILITY .....	141
<i>Roger O. Smith</i>	

A LATENCY-DEFINED EDGE NODE PLACEMENT SCHEME FOR OPPORTUNISTIC SMART CITIES.....	142
<i>Oluwashina Madamori, Esther Max-Onakpoya, Gregory D. Erhardt, Corey E. Baker</i>	
RENDEZVOUS DELIVERY: UTILIZING AUTONOMOUS ELECTRIC VEHICLES TO IMPROVE THE EFFICIENCY OF LAST MILE PARCEL DELIVERY IN URBAN AREAS.....	148
<i>Frederik P. Nolte, Nils Wilken, Christian Bartelt</i>	
HEIMDALL: AN AI-BASED INFRASTRUCTURE FOR TRAFFIC MONITORING AND ANOMALIES DETECTION .....	154
<i>Andrea Atzori, Silvio Barra, Salvatore Carta, Gianni Fenu, Alessandro Sebastian Podda</i>	
KEYNOTE: EDGE INTELLIGENCE - EMERGING SOLUTIONS AND OPEN CHALLENGES.....	160
<i>Mario Luca Bernardi</i>	
LAMBDA: AN OPEN FRAMEWORK FOR DEEP NEURAL NETWORK ACCELERATORS SIMULATION .....	161
<i>Enrico Russo, Maurizio Palesi, Salvatore Monteleone, Davide Patti, Giuseppe Ascia, Vincenzo Catania</i>	
KEYWORD SPOTTING FOR INDUSTRIAL CONTROL USING DEEP LEARNING ON EDGE DEVICES .....	167
<i>Fabian Hölzke, Hameem Ahmed, Frank Golasowski, Dirk Timmermann</i>	
KEYNOTE: ARES: A DEEP REINFORCEMENT LEARNING TOOL FOR BLACK-BOX TESTING OF ANDROID APPS .....	173
<i>Andrea Romdhana, Alessio Merlo</i>	
KEYNOTE: INTELLIGENT IOT ARCHITECTURES TO SUPPORT DISTRIBUTED COGNITIVE APPLICATIONS .....	174
<i>Marco Picone</i>	
KEYNOTE: EXPLAINABLE-BY-DESIGN DEEP LEARNING.....	175
<i>Plamen Angelov</i>	
APPLYING “EARABLE” INERTIAL SENSING FOR REAL-TIME HEAD POSTURE DETECTION.....	176
<i>Meera Radhakrishnan, Kushaan Misra, V. Ravichandran</i>	
A DISCREET WEARABLE LONG-RANGE EMERGENCY SYSTEM BASED ON EMBEDDED MACHINE LEARNING .....	182
<i>Charalampos Orfanidis, Rayén Bel Haj Hassen, Armando Kwiek, Xenofon Fafoutis, Martin Jacobsson</i>	
PULSYNC: THE HEART RATE VARIABILITY AS A UNIQUE FINGERPRINT FOR THE ALIGNMENT OF SENSOR DATA ACROSS MULTIPLE WEARABLE DEVICES .....	188
<i>Florian Wolling, Kristof Van Laerhoven, Pekka Siirtola, Juha Röning</i>	
A MOBILE-BASED MULTIMODAL FRAMEWORK FOR PERVASIVE HEALTH MONITORING .....	194
<i>Rafail-Evangelos Mastoras, Andreas Triantafyllidis, Dimitrios Giakoumis, Rafail-Konstantinos Kordonias, Aristotelis Papaprodromou, Fotis Nalbadis, Sofia Segkouli, Evdoxia-Eirini Lithoxidou, Charalabos Georgiadis, Ioannis Paliokas, Konstantinos Votis, Dimitrios Tzovaras</i>	

KEYNOTE: DIGITAL HEALTH TECHNOLOGIES AND THEIR ROLE IN THE DEVELOPMENT OF PRECISION REHABILITATION INTERVENTIONS .....	200
<i>Paolo Bonato</i>	
TRUST MODEL FOR EFFICIENT HONEST BROKER BASED HEALTHCARE DATA ACCESS AND PROCESSING .....	201
<i>Mauro Lemus Alarcon, Minh Nguyen, Saptarshi Debroy, Naga Ramya Bhamidipati, Prasad Calyam, Abu Mosa</i>	
BCG & ECG-BASED SECURE COMMUNICATION FOR MEDICAL DEVICES IN BODY AREA NETWORKS .....	207
<i>Nils Beck, Si Zuo, Stephan Sigg</i>	
SKIN TONE, CONFIDENCE, AND DATA QUALITY OF HEART RATE SENSING IN WEAROS SMARTWATCHES .....	213
<i>Ishita Ray, Daniyal Liaqat, Moshe Gabel, Eyal De Lara</i>	
INVESTIGATING THE RELATIONSHIP BETWEEN DATA LITERACY AND TRACKER ABANDONMENT .....	220
<i>Simon Eden-Walker, Jin Kang, Audrey Girouard</i>	
KEYNOTE: ORCHESTRATING VEHICULAR COMPUTING RESOURCES TO FORM FLOATING VIRTUAL EDGE SERVERS.....	226
<i>Takamasa Higuchi</i>	
A SYSTEM FOR REAL-TIME ON-STREET PARKING DETECTION AND VISUALIZATION ON AN EDGE DEVICE .....	227
<i>Akihiro Matsuda, Tomokazu Matsui, Yuki Matsuda, Hirohiko Suwa, Keiichi Yasumoto</i>	
PERFORMANCE STUDY OF THE LANE CHANGE CONTROL USING VEHICLE COMMUNICATIONS FOR ALLEVIATING CONGESTION .....	233
<i>Hiroaki Morino, Yusei Kage</i>	
RELIABLE MULTI-DIFFUSION WITH LIMITED MEMORY IN VEHICULAR NETWORKS .....	239
<i>Guillaume Béduneau, Ghada Jaber, Bertrand Ducourthial</i>	
A DYNAMIC MIX-ZONE SCHEME CONSIDERING COMMUNICATION DELAY FOR LOCATION PRIVACY IN VEHICULAR NETWORKS .....	245
<i>Rei Yamazaki, Masashi Yoshida, Hiroshi Shigeno</i>	
A REINFORCEMENT LEARNING ENVIRONMENT FOR MULTI-SERVICE UAV-ENABLED WIRELESS SYSTEMS.....	251
<i>Damiano Brunori, Stefania Colonnese, Francesca Cuomo, Luca Iocchi</i>	
EVALUATION OF A ROAD PRICING METHOD BASED ON DEMAND DISTRIBUTION IN MICRO TRAFFIC SIMULATION.....	257
<i>Koki Murata, Tomoya Kawakami</i>	
UTILITY-BASED VEHICLE ROUTING INTEGRATING USER PREFERENCES .....	263
<i>Veronika Lesch, Marius Hadry, Samuel Kounev, Christian Krupitzer</i>	
ROBOBUS: A DIVERSE AND CROSS-BORDER PUBLIC TRANSPORT DATASET .....	269
<i>Georgios Varisteas, Raphaël Frank, François Robinet</i>	
EVALUATING MODELS FOR ESTIMATING SCHEDULE DEVIATION IN PUBLIC TRANSIT .....	275
<i>Jorge Adorno Nieves, Brian D. Torres Alvarado, Sean J. Barbeau, Miguel A. Labrador</i>	

MEMA: FAST INFERENCE OF MULTIPLE DEEP MODELS .....	281
<i>Jeroen Galjaard, Bart Cox, Amirmasoud Ghiassi, Lydia Y. Chen, Robert Birke</i>	
MOBI-TRACK: DISTILLING DIRECT PATH IN TIME DOMAIN FOR HIGH ACCURACY WIFI TRACKING.....	287
<i>Zheng Yang, Feng Wang, Wei Gong</i>	
ARCHITECTURE AND PERVASIVE PLATFORM FOR MACHINE LEARNING SERVICES IN INDUSTRY 4.0.....	293
<i>Philippe Lalanda, German Vega, Humberto Cervantes, Denis Morand</i>	
FORECASTING PARKING LOTS AVAILABILITY: ANALYSIS FROM A REAL-WORLD DEPLOYMENT .....	299
<i>Manuele Barraco, Nicola Bicocchi, Marco Mamei, Franco Zambonelli</i>	
IMPROVING LAND USE CLASSIFICATION USING HUMAN MOBILITY-BASED HIERARCHICAL PLACE EMBEDDINGS.....	305
<i>Toru Shimizu, Takahiro Yabe, Kota Tsubouchi</i>	
TOWARDS A STAGING ENVIRONMENT FOR THE INTERNET OF THINGS .....	312
<i>Jossekin Beilharz, Philipp Wiesner, Arne Boockmeyer, Florian Brokhausen, Ilja Behnke, Robert Schmid, Lukas Pirl, Lauritz Thamsen</i>	
ULTRA-FAST MACHINE LEARNING CLASSIFIER EXECUTION ON IOT DEVICES WITHOUT SRAM CONSUMPTION .....	316
<i>Bharath Sudharsan, Pankesh Patel, John G. Breslin, Muhammad Intizar Ali</i>	
TOWARDS PREDICTIVE SAFETY MAINTENANCE FOR IOT EQUIPPED BIKES .....	320
<i>Viktor Matkovic, Marian Waltereit, Torben Weis</i>	
ENABLING PERVASIVE FEDERATED LEARNING USING VEHICULAR VIRTUAL EDGE SERVERS .....	324
<i>Anran Du, Yicheng Shen, Lewis Tseng, Takamasa Higuchi, Seyhan Ucar, Onur Altintas</i>	
TOWARDS AUTOMATED DATA SHARING IN PERSONAL DATA STORES .....	328
<i>Yashothara Shanmugarasa, Hye-Young Paik, Salil S. Kanhere, Liming Zhu</i>	
HUMAN KNOWLEDGE BASED EFFICIENT INTERACTIVE DATA ANNOTATION VIA ACTIVE WEAKLY SUPERVISED LEARNING.....	332
<i>Osamu Saisho, Takeshi Ohguro, Jingyu Sun, Hiroshi Imamura, Susumu Takeuchi, Daigoro Yokozeki</i>	
LOCATION-AWARE CACHING VIA PREDICTING HETEROGENEOUS FILE PREFERENCES IN MOBILE NETWORKS .....	336
<i>Hyun-Soung You, Ji-Hong Kim, Won-Yong Shin, Sang-Wook Kim</i>	
TOWARDS ENERGY EFFICIENT MOBILE DATA COLLECTION IN CLUSTER-BASED IOT NETWORKS.....	340
<i>Sana Benhamaid, Hicham Lakhlef, Abdelmadjid Bouabdallah</i>	
ADAPTIVE & SIMULTANEOUS PERVASIVE VISIBLE LIGHT COMMUNICATION AND SENSING .....	344
<i>Ila Gokarn, Archan Misra</i>	

HOW TO CATCH THEM ALL? ENHANCED DATA COLLECTION FOR EMOTION RECOGNITION IN THE FIELD.....	348
<i>Maciej Dziezyc, Joanna Komoszynska, Stanislaw Saganowski, Magda Boruch, Jakub Dziwinski, Katarzyna Jablonska, Dominika Kunc, Przemyslaw Kazienko</i>	
TOWARDS BATTERY-LESS RF SENSING.....	352
<i>Manila Kodali, Le Ngu Nguyen, Stephan Sigg</i>	
NON-INTRUSIVE CONTINUOUS USER IDENTIFICATION FROM ACTIVITY ACOUSTIC SIGNATURES .....	356
<i>Soumyajit Chatterjee, Bivas Mitra, Sandip Chakraborty</i>	
TAGUARD: EXPOSING THE LOCATION OF ACTIVE EAVESDROPPER IN PASSIVE RFID SYSTEM.....	360
<i>Wei Sun</i>	
TOWARDS RECOGNIZING EMOTION IN THE LATENT SPACE .....	364
<i>Marios Fanourakis, Guillaume Chanel, Rayan Elalamy, Phil Lopes</i>	
PARACOOK: OPTIMAL COOKING SUPPORT SYSTEM FOR MULTIPLE DISHES.....	368
<i>Jin Nakabe, Teruhiro Mizumoto, Hirohiko Suwa, Keiichi Yasumoto</i>	
ANTONYM DISAMBIGUATION FOR A GERMAN-LANGUAGE CONVERSATIONAL INTELLIGENT TUTORING SYSTEM.....	372
<i>Tomasz Sosnowski, Kristina Yordanova</i>	
DESIGNING COMPREHENSIVE CYBER THREAT ANALYSIS PLATFORM: CAN WE ORCHESTRATE ANALYSIS ENGINES? .....	376
<i>Takeshi Takahashi, Yuki Umemura, Chansu Han, Tao Ban, Keisuke Furumoto, Ohnori Nakamura, Katsunari Yoshioka, Junichi Takeuchi, Noboru Murata, Yoshiaki Shiraishi</i>	
EXPLORATORY ANALYSIS OF NOSE-GESTURE FOR SMARTPHONE AIDED TYPING FOR USERS WITH CLINICAL CONDITIONS.....	380
<i>Pragma Kar, Krishna Mishra, Sudipro Ghosh, Sandip Chakraborty, Samiran Chattopadhyay</i>	
MOSEN: SENSOR NETWORK OPTIMIZATION IN MULTIPLE-OCCUPANCY SMART HOMES.....	384
<i>Yuting Zhan, Hamed Haddadi</i>	
EAT2PIC: FOOD-TECH DESIGN AS A HEALTHY NUDGE WITH SMART CHOPSTICKS AND CANVAS.....	389
<i>Rei Nakaoka, Yugo Nakamura, Yuki Matsuda, Shinya Misaki, Keiichi Yasumoto</i>	
DEMO: USING SMARTPHONE AND OPTICAL MOUSE TO ENHANCE WEB INTERACTION .....	392
<i>Zhiwei Wang, Yihui Yan, Qianyi Huang, Haitian Ren, Yizhou Zhang, Zhice Yang</i>	
BURST - A DYNAMIC BUS ROUTING SYSTEM.....	395
<i>Jan Gerhards, Dominik Held, Tim Schneider, Pascal Hirmer</i>	
AUTOMATIC AND INTELLIGENT COMPOSITION OF PERVASIVE APPLICATIONS .....	398
<i>K. Delcourt, F. Adreit, J.-P. Arcangeli, K. Hacid, S. Trouilhet, W. Younes</i>	
SCALABLE DISTRIBUTED DATA ANONYMIZATION .....	401
<i>Sabrina De Capitani Di Vimercati, Dario Facchinetti, Sara Foresti, Gianluca Oldani, Stefano Paraboschi, Matthew Rossi, Pierangela Samarati</i>	



ROUTING OVER MULTIPLE TECHNOLOGIES WITH RODENT .....	404
<i>Brandon Foubert, Nathalie Mitton</i>	
VIRTUAL ENVIRONMENT FOR EVALUATING THE QOS OF DISTRIBUTED MOBILE APPLICATIONS.....	407
<i>Sergio Laso, Javier Berrocal, Pablo Fernández, Antonio Ruiz-Cortés, Juan M. Murillo</i>	
A MEDICAL TELE-TUTORING SYSTEM FOR THE EMERGENCY SERVICE .....	410
<i>Anna Lina Ruscelli, Gabriele Cecchetti, Igor Barsanti, Mirco Manciuilli, Piero Paolini, Piero Castoldi</i>	
LOGLIDAR: AN INTERNET OF THINGS SOLUTION FOR COUNTING AND SCALING LOGS .....	413
<i>Felip Martí, Abdur Rahim Mohammad Forkan, Prem Prakash Jayaraman, Chris McCarthy, Hadi Ghaderi</i>	
5G EDGE COMPUTING ENHANCED MOBILE AUGMENTED REALITY.....	416
<i>Jacky Cao, Xiang Su</i>	
IOT THING TO SERVICE SEMANTIC MATCHING .....	418
<i>Nisrine Bnouhanna, Rute C. Sofia, Alexander Pretschner</i>	
PRONUNCIATION TRAINING THROUGH SENSING OF TONGUE AND LIP MOTION VIA SMARTPHONE.....	420
<i>Aslan B. Wong, Kaishun Wu</i>	
A GRAPH-BASED APPROACH TO DETECT DOB ATTACK.....	422
<i>Diya Thomas</i>	
TOWARDS ROBUST ANDROID MALWARE DETECTION MODELS USING ADVERSARIAL LEARNING.....	424
<i>Hemant Rathore, Sanjay K. Sahay</i>	
USABLE DIFFERENTIAL PRIVACY FOR THE INTERNET-OF-THINGS.....	426
<i>Patrick Kühnreiber, Delphine Reinhardt</i>	
COMBINING SYMBOLIC AND DATA-DRIVEN METHODS FOR GOAL RECOGNITION .....	428
<i>Nils Wilken, Heiner Stuckenschmidt, Christian Bartelt</i>	
INTENT RECOGNITION IN SMART HOMES WITH PROBLOG.....	430
<i>Gary Smith, Ron Petrick, Vaishak Belle</i>	
DEVELOPMENT OF A GENETIC ALGORITHM FOR ESTIMATION FOR A DEGROOT OPINION DIFFUSION MODEL.....	432
<i>Kara Layne Johnson, Nicole Bohme Carnegie</i>	
CONTEXT-DRIVEN ABNORMAL SEMANTIC EVENT RECOGNITION FOR HEALTHCARE APPLICATIONS.....	434
<i>Amanda Venceslau, Vânia Vidal, Rossana Andrade</i>	
ARTIFACT: MOBILITY IMPROVES ACCURACY: PRECISE ROBOT MANIPULATION WITH COTS RFID SYSTEMS .....	436
<i>Haoyu Wang, Si Chen, Wei Gong</i>	
ARTIFACT: OPPORTUNISTIC FEDERATED LEARNING: AN EXPLORATION OF EGOCENTRIC COLLABORATION FOR PERVASIVE COMPUTING APPLICATIONS.....	438
<i>Sangsu Lee, Xi Zheng, Jie Hua, Haris Vikalo, Christine Julien</i>	

ARTIFACT: VIRTUAL ENVIRONMENT FOR EVALUATING THE QOS OF DISTRIBUTED MOBILE APPLICATIONS .....	440
<i>Sergio Laso, Javier Berrocal, Pablo Fernández, Antonio Ruiz-Cortés, Juan M. Murillo</i>	
ARTIFACT: VOLTAIRE: PRECISE ENERGY-AWARE CODE OFFLOADING DECISIONS WITH MACHINE LEARNING.....	442
<i>Martin Breitbach, Janick Edinger, Siim Kaupmees, Heiko Trötsch, Christian Krupitzer, Christian Becker</i>	
ARTIFACT: THE FEASIBILITY OF DENSE INDOOR LORAWAN TOWARDS PASSIVELY SENSING HUMAN PRESENCE .....	444
<i>Jascha Gröbel, Tyler Thrash, Didier H��lal, Robert W. Sumner, Christoph H��lscher, Victor R. Schinazi</i>	
ARTIFACT: MASA: RESPONSIVE MULTI-DNN INFERENCE ON THE EDGE .....	446
<i>Bart Cox, Jeroen Galjaard, Amirmasoud Ghiassi, Robert Birke, Lydia Y. Chen</i>	
ARTIFACT: A FEDERATED LEARNING AGGREGATION ALGORITHM FOR PERVASIVE COMPUTING: EVALUATION AND COMPARISON.....	448
<i>Sannara Ek, Fran��ois Portet, Philippe Lalanda, German Vega</i>	
ARTIFACT: SCALABLE DISTRIBUTED DATA ANONYMIZATION.....	450
<i>Sabrina De Capitani Di Vimercati, Dario Facchinetti, Sara Foresti, Gianluca Oldani, Stefano Paraboschi, Matthew Rossi, Pierangela Samarati</i>	
KEYNOTE: MACHINE LEARNING AND DATA ANALYSIS OF MULTIMODAL AFFECTIVE AND PAIN DATA.....	452
<i>Friedhelm Schwenker</i>	
BENCHMARKING ANNOTATION PROCEDURES FOR MULTI-CHANNEL TIME SERIES HAR DATASET .....	453
<i>H��lya Avsar, Erik Altermann, Christopher Reining, Fernando Moya Rueda, Gernot A. Fink, Michael Ten Hompel</i>	
DISCOVERING TYPES OF SMARTPHONE USAGE SESSIONS FROM USER-APP INTERACTIONS.....	459
<i>Bj��rn Friedrichs, Liam D. Turner, Stuart M. Allen</i>	
TOWARDS EEG-BASED PERFORMANCE ASSESSMENT IN DATASET ANNOTATION TASKS .....	465
<i>Silvia M. Massa, Marta Pibiri, Daniele Riboni</i>	
DATA LABELLING IN THE WILD: ANNOTATING FREE-LIVING ACTIVITIES AND PARKINSON'S DISEASE SYMPTOMS.....	471
<i>Catherine Morgan, Farnoosh Heidarvincheh, Ian Craddock, Ryan McConville, Miquel Perello Nieto, Emma L. Tonkin, Alessandro Masullo, Antonis Vafeas, Mickey Kim, Roisin McNaney, Gregory J. L. Tourte, Alan Whone</i>	
SIGNALIGNER PRO: A TOOL TO EXPLORE AND ANNOTATE MULTI-DAY RAW ACCELEROMETER DATA .....	475
<i>Aditya Ponnada, Seth Cooper, Qu Tang, Binod Thapa-Chhetry, Josh Aaron Miller, Dinesh John, Stephen Intille</i>	
KEYNOTE: TRAINING WITH IMPERFECT AND WEAK LABELS .....	481
<i>Ra��l Santos-Rodr��guez</i>	

KEYNOTE: IOT IN EDGE AND FOG ENVIRONMENTS .....	482
<i>Janick Edinger</i>	
A DYNAMIC TASK OFFLOADING METHOD WITH CENTRALIZED CONTROLLER TO IMPROVE TASK SUCCESS RATE .....	483
<i>Mutsumi Toyoda, Hayata Satake, Hiroshi Shigeno</i>	
INTRAOPERATIVE HYPOTENSION PREDICTION SYSTEM BY CONSIDERING PERSONAL LIFESTYLE AND MEDICAL HISTORY .....	489
<i>Riku Inada, Chiaki Doi, Yuki Yamasaki, Hiroshi Shigeno, Hiroyuki Seki</i>	
USING HUMAN POSE ESTIMATION FOR USER-DEFINED INDOOR LOCATION SENSING .....	495
<i>Sinan Chen, Sachio Saiki, Masahide Nakamura</i>	
NAVIMINE: A TOOL FOR MINING TRAJECTORIES THROUGH BEHAVIOR PREDICTION .....	502
<i>Yiming Tian, Takuya Maekawa, Takahiro Hara, Yojiro Yokomori, Takashi Kitagawa</i>	
A LOW-RATE DDOS STRATEGY FOR UNKNOWN BOTTLENECK LINK CHARACTERISTICS .....	508
<i>Yuta Takahashi, Hiroshi Inamura, Yoshitaka Nakamura</i>	
ZERO TRUST FEDERATION: SHARING CONTEXT UNDER USER CONTROL TOWARDS ZERO TRUST IN IDENTITY FEDERATION .....	514
<i>Koudai Hatakeyama, Daisuke Kotani, Yasuo Okabe</i>	
EVALUATION AND ADAPTION OF MAINTENANCE PREDICTION METHODS IN MIXED PRODUCTION LINE SETUPS BASED ON ANOMALY DETECTION .....	520
<i>Sebastian Soller, Bastian Fleischmann, Matthias Kranz, Gerold Hölzl</i>	
KEYNOTE: ADVANCES AND CHALLENGES OF INDUSTRIAL IOT .....	526
<i>Alexander Artemenko</i>	
AN ALGORITHM FOR DEPENDENCY-PRESERVING SMART HOME UPDATES .....	527
<i>Peter Zdankin, Matthias Schaffeld, Marian Waltereit, Oskar Carl, Torben Weis</i>	
TOWARDS PROGRAMMING PARTICIPATORY IOT APPLICATIONS WITH MOBILITY FOR SMART CITIES .....	533
<i>Felipe Oliveira Carvalho, Markus Endler</i>	
A POLICY-BASED APPROACH FOR MANAGING SOCIALLY APPROPRIATE INTERACTION BEHAVIOURS IN IOT COLLECTIVES .....	539
<i>Amna Batool, Seng W. Loke, Niroshinie Fernando, Jonathan Kua</i>	
KEYNOTE: UNCOVERING VULNERABILITIES IN BLUETOOTH DEVICES WITH AUTOMATED BINARY ANALYSIS .....	545
<i>Zhiqiang Lin</i>	
MULTI-WEATHER CLASSIFICATION USING EVOLUTIONARY ALGORITHM ON EFFICIENTNET .....	546
<i>Yulong Zhang, Jingtao Sun, Mingkang Chen, Qiang Wang, Yuan Yuan, Rongzhe Ma</i>	
LEVERAGING IOT AND WEATHER CONDITIONS TO ESTIMATE THE RIDERS WAITING FOR THE BUS TRANSIT ON CAMPUS .....	552
<i>Ismail Arai, Ahmed Elnoshokaty, Samy El-Tawab</i>	

ARCIOT: ENABLING INTUITIVE DEVICE CONTROL IN THE INTERNET OF THINGS THROUGH AUGMENTED REALITY .....	558
<i>Jie Hua, Sangsu Lee, Gruia-Catalin Roman, Christine Julien</i>	
MLMG: MULTI-LOCAL AND MULTI-GLOBAL MODEL AGGREGATION FOR FEDERATED LEARNING .....	565
<i>Yang Qin, Masaaki Kondo</i>	
SCALING SPECTROGRAM DATA REPRESENTATION FOR DEEP LEARNING ON EDGE TPU .....	572
<i>Seyedehfaezeh Hosseininoorbin, Siamak Layeghy, Brano Kusy, Raja Jurdak, Marius Portmann</i>	
SECURING EDGE-BASED IOT NETWORKS WITH SEMI-SUPERVISED GANS .....	579
<i>Santosh Kumar Nukavarapu, Tamer Nadeem</i>	
ADAPTIVE COOPERATIVE DISTRIBUTED COMPRESSED SENSING FOR EDGE DEVICES: A MULTIAGENT DEEP REINFORCEMENT LEARNING APPROACH .....	585
<i>Masatoshi Sekine, Satoshi Ikada</i>	
RCC: A DISTRIBUTED DATA STREAMING SOFTWARE LIBRARY FOR ROBOT-CLOUD PLATFORMS .....	592
<i>Yuhong Zhang, Jingtao Sun, Chen Ouyang, Mingkang Chen, Xinyao Wang, Qiang Wang</i>	
OPTIMIZATION AND LEARNING FOR DATA OFFLOADING AND RESOURCE MANAGEMENT IN MOBILE EDGE COMPUTING.....	598
<i>Yang Yang, M. Cenk Gursoy</i>	
KEYNOTE: LONG-TERM AFFECT AND ACTIVITY ASSESSMENT ON THE WRIST .....	604
<i>Kristof Van Laerhoven</i>	
TOWARDS PUTTING DEEP LEARNING ON THE WRIST FOR ACCURATE HUMAN ACTIVITY RECOGNITION.....	605
<i>Shrehal Bohra, Vinayak Naik, Varun Yeligar</i>	
QUATERNI-ON: CALIBRATION-FREE MATCHING OF WEARABLE IMU DATA TO JOINT ESTIMATES OF AMBIENT CAMERAS.....	611
<i>Jochen Kempfle, Kristof Van Laerhoven</i>	
ROCK BEATS SCISSOR: SVM BASED GESTURE RECOGNITION WITH DATA GLOVES .....	617
<i>Philipp Achenbach, Philipp Niklas Müller, Tobias Alexander Wach, Thomas Tregel, Stefan Göbel</i>	
WRISTO <sub>2</sub> : RELIABLE PERIPHERAL OXYGEN SATURATION READINGS FROM WRIST-WORN PULSE OXIMETERS .....	623
<i>Caleb Phillips, Daniyal Liaqat, Moshe Gabel, Eyal De Lara</i>	
DIGITAL BIOMARKERS: USING SMARTWATCH DATA FOR CLINICALLY RELEVANT OUTCOMES .....	630
<i>Karan Bhavsar, Shivam Singhal, Vivek Chandel, Avijit Samal, Sundeep Khandelwal, Nasimuddin Ahmed, Avik Ghose</i>	
EXPLORING EPILEPTIC SEIZURE DETECTION WITH COMMERCIAL SMARTWATCHES .....	636
<i>Theresa Tobollik, Sujay Shalawadi, Christopher Getschmann, Florian Echtler</i>	
TASK-BASED CONTINUOUS AUTHENTICATION USING WRIST-WORN DEVICES.....	642
<i>Zaire Ali, Jamie Payton</i>	

DO PARTNER APPS OFFER THE SAME LEVEL OF PRIVACY PROTECTION? THE CASE OF WEARABLE APPLICATIONS .....	648
<i>Andrei Kazlouski, Thomas Marchioro, Harry Manifavas, Evangelos Markatos</i>	
KEYNOTE - TRANSPARENT, TRUSTWORTHY AND PRIVACY-PRESERVING SUPPLY CHAINS .....	654
<i>Salil S. Kanhere</i>	
TRUSTED VIDEO STREAMING ON EDGE DEVICES .....	655
<i>Narendra Prabhu, Daksha Naik, Fatima Anwar</i>	
INTRUSION DETECTION SYSTEM FOR BLUETOOTH MESH NETWORKS: DATA GATHERING AND EXPERIMENTAL EVALUATIONS.....	661
<i>Andrea Lacava, Emanuele Giacomini, Francesco D'Alterio, Francesca Cuomo</i>	
PRIVACY PRESERVING FRAMEWORK FOR BIG DATA MANAGEMENT IN SMART BUILDINGS .....	667
<i>Catherine Inibhunu, Carolyn McGregor</i>	
ENABLING A SECURED COMMUNICATION IN DISTRIBUTED IOT USING THE SMART SYSTEMS SERVICE INFRASTRUCTURE .....	674
<i>Jiahang Chen, Michael Schluse, Jürgen Roßmann</i>	
EDGE2GUARD: BOTNET ATTACKS DETECTING OFFLINE MODELS FOR RESOURCE-CONSTRAINED IOT DEVICES .....	680
<i>Bharath Sudharsan, Dineshkumar Sundaram, Pankesh Patel, John G. Breslin, Muhammad Intizar Ali</i>	
PRIVACY ABCS: NOW READY FOR YOUR WALLETS! .....	686
<i>Jan Hajny, Petr Dzurenda, Raul Casanova-Marques, Lukas Malina</i>	
DISCRETE DISTRIBUTION ESTIMATION WITH LOCAL DIFFERENTIAL PRIVACY: A COMPARATIVE ANALYSIS.....	692
<i>Ba Dung Le, Tanveer Zia</i>	
SECURITY ATTACKS ON MULTI-STAGE PROOF-OF-WORK .....	698
<i>Paolo D'Arco, Zahra Ebadi Ansaroudi</i>	
A DATA SECURITY AND PRIVACY RISK MANAGEMENT FRAMEWORK FOR WBAN BASED HEALTHCARE APPLICATIONS* .....	704
<i>Pangkaj Chandra Paul, John Loane, Fergal McCaffery, Gilbert Regan</i>	
TRUST AND TRUSTWORTHINESS: WHAT THEY ARE AND HOW TO ACHIEVE THEM .....	711
<i>Jinghui Li, Bifei Mao, Zhizhang Liang, Zeqi Zhang, Qiushi Lin, Xin Yao</i>	
DETECTING MALICIOUS COVID-19 URLS USING MACHINE LEARNING TECHNIQUES.....	718
<i>Jamil Ispahany, Rafiqul Islam</i>	
CAMOUFLAGE LEARNING .....	724
<i>Stephan Sigg, Le Ngu Nguyen, Jing Ma</i>	
YOU HAD TO BE THERE: PRIVATE VIDEO SHARING FOR MOBILE PHONES USING FULLY HOMOMORPHIC ENCRYPTION.....	730
<i>Brent Lagesse, Gabriel Nguyen, Utsav Goswami, Kevin Wu</i>	

SIMULATION-BASED ANALYSIS OF THREATS TO LOCATION PRIVACY IN FOG  
COMPUTING ..... 736  
*Theresa Wettig, Zoltán Ádám Mann*

**Author Index**