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EDITORIAL

Cover feature: guest editors' introduction title: internet of things for everyday living: ubiquitous intelligence at Scale

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1 Introduction

This special issue on Internet of Things for Everyday Living: Ubiquitous Intelligence at Scale provides some highlights of the latest research on ubiquitous intelligence and applications in healthcare, agriculture, retail, and context-aware services, among others. The special issue is aimed at researchers and practitioners interested in creating scalable IoT solutions that also address security and privacy challenges. Addressing the security and privacy challenges present opportunities for realistic deployment of IoT applications. To this end, this special issue presents both prototype IoT systems, IoT frameworks, semantic data management frameworks, and systematic surveys.

Humans encounter various challenges in their daily activities. Some of the challenges to everyday living include supporting the elderly for assisted living, digital health, health monitoring and medication adherence, security and surveillance, urban computing, disaster management, energy and water management, agricultural production, provision of personalized services including recommendations, etc. It is possible to leverage ubiquitous intelligence to address some of the challenges. However, overcoming the challenges relies on corresponding developments in sensor networks and technologies, framework and application programming interfaces (APIs) that make it possible to provide services to people in their living, work, leisure or commuting environments. In addition, technologies such as cloud, fog, and edge computing, Semantic Web, artificial intelligence and machine learning may be used to collect, store, manage, and process ubiquitous intelligence to develop scalable IoT solutions.

2 About this issue

This special issue received a total of 78 papers out of which 27 papers were accepted for publication. We adopted a double-blind peer review process, and, in some cases, papers were revised more than once before acceptance. Each paper was reviewed by at least two peer reviewers before the Guest Editors made recommendations to accept, reject, or revise. The accepted papers cover the following general themes: *security (5 papers)*, *context awareness (6 papers)*, and *applications* in agriculture, food, energy, and water (6 papers), applications in health (5 papers), and applications in other areas (5 papers).

Security and Privacy The papers cover privacy preserving data aggregation, smartphone attack detection, secure firmware update, session key exchange for Internet of Things, and light-weight cryptographic algorithms for resource constrained IoT applications. Gheisari et al. (2022) presents a privacy-preserving architecture for data aggregation in an IoT environment, which makes use of homomorphic Paillier encryption, K-means, a one-way hash chain, and the Chinese Remainder Theorem. Javed et al. (2020) develops and evaluates an AlphaLogger Android application that runs in the background and collects data from the smartphone hardware sensors to infer the keystrokes. Lu et al. (2020) presents a smart-contract-enabled firmware validation system that uses a distributed membership-based firmware sharing system for

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firmware distribution and a blockchain for smart-contract-enabled firmware validation to minimize cyberattacks and enhance the use of IoT-enabled applications. Kumar et al. (2020) proposes a scheme to overcome the weakness of the lightweight anonymous user authenticated session key exchange scheme for Internet of Things deployment. The scheme aims at mitigating smart card loss and stolen verifier attacks. Finally, Aswathy and Malarvizhi (2021) introduces a lightweight elliptic curve cryptography (ECC) based algorithm coupled with a linear congruential method able to strengthen the security of low resource IoT environments.

Context awareness and semantic representation The papers cover offloading context aware computing on mobile edge computing, using temporal features to recognize similar activities, using ambient intelligence and user modeling to model an intelligent smart home system, and data fusion for heterogeneous sensor data, among others. In the article, "Using Model's Temporal Features and Hierarchical Structure for Similar Activity Recognition," by Li et al. develops an activity recognition approach based on a hierarchical structure, duration, and time block characteristics to identify similar activities in an environment with ambient sensors. The article by Al-Baltah et al. (2020) proposes a data fusion framework to address scalability challenges associated with data fusion for heterogeneous sensor data in IoT. Pignaton de Freitas et al. (2020) uses ontologies to support information modeling and sharing in cloud robotics (CR) to support the provision of ubiquitous intelligent services based on CR-systems. A model of a smart home system is created by Djuric et al. (2021) that employs IoT, ambient intelligence, user profiling, and multimedia. The system adapts to the user's needs based on habits, time of day, and the weather. Farahbakhsh et al. (2021) presents a context-aware approach to computation offloading for mobile edge computing. The paper considers changing contexts that are collected and processed to make offloading decisions. Finally, Urkude and Pandey (2021) employs Semantic Web-based representation and reasoning to develop a semantic data management framework to reduce the processing load on resource-constrained IoT devices due to the bulky size of annotated sensor datasets.

Applications in healthcare The papers cover sedentary behavior analysis, a semantic framework for IoT-based healthcare applications, urine infection prediction from smart home data, and using biological and behavioral indicators to monitor the elderly. Zgheib et al. (2020) presents a semantic framework that distributes semantic reasoning over a semantic middleware to address the limitations of real time processing that are faced in large-scale applications like health monitoring systems. Bhatia et al. (2020a) presents a layered model to monitor and detect infections in urine. The model is based on mathematical quantification of urine parameters and a temporal artificial neural network and is tested on real patient data. Hosseinzadeh et al. (2020) presents a health monitoring system for medical teams to monitor and assess a disabled or elderly's behavioral activity as well as the biological parameters, applying sensor technology through the IoT devices. The authors apply and compare the performance of various ML models such as sequential minimal optimization (SMO), multi-layer perceptron (MLP) and Naïve Bayes (NB) classifiers. Manocha et al. (2021) present an e-healthcare framework that uses IoT and fog computing to identify sedentary behavior. The framework uses weighted k-Means clustering at the fog layer, and weighted k-Means clustering and artificial neural network at the cloud layer to predict health severity. Finally, Saleemi et al. (2020) presents a mapping study that established that ubiquitous technologies have been employed in a wide range of healthcare applications. However, Saleemi et al. also recommend additional studies.

Applications in agriculture, energy, and water Poonia and Bhatnagar (2022) discusses a decision support system for crop water needs. It uses temperature sensors to acquire real-time environmental factors and an android-based smartphone to communicate with sensors via Bluetooth technology. Wu et al. (2020) presents a simulation-based approach for agricultural monitoring based on underground sensing that is aimed at farming efficiency and pollution reduction. The authors demonstrate that such underground sensing is scalable. Bhatia et al. (2020b) presents a quantum-temporal minimization algorithm for IoT data acquisition. Tomazzoli et al. (2020) presents a system architecture based on IoT and machine learning techniques to enable impaired people in a smart home to delegate decision making involved in managing energy efficiency. Abdalgader et al. (2020) in the article "IoT-based System to Measure Thermal Insulation Efficiency" present an IoT system that monitors the efficiency of thermal insulation by analyzing weather conditions. Finally, Shahra and Wu (2020) presents a dynamic approach to sensor placement based on an evolutionary algorithm. The approach aims to optimize sensor placement for large water distribution systems and decrease the time taken to detect water contaminants.

Other applications The other papers cover applications such as retail, disaster management, and localization. Alipio et al. (2020) discusses a system for in-store localization in a supermarket using image processing and object detection. The system uses ultra-wideband (UWB) indoor positioning technique and single shot multibox detection (SSD) technique to monitor customer shopping path and real-time customer traffic, respectively. Nawi et al. (2022) considered the acceptance of IoT in the retail industry using a cross-sectional research design to identify critical success factors. Kaur and Bhatia (2021) presents a Stochastic Game Network (SGN) technique for decision making to generate advanced warning notifications about disasters

using sensor data from IoT-based smart industry. Fazel et al. (2023) describes a mixed methodology that was employed to identify and highlight the main benefits of using fog computing in IoT. Finally, Zhu et al. (2020) describe an approach to bandwidth allocation to make the execution of web crawlers more efficient.

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References

Abdalgader K, Al Ajmi R, Saini DK (2020) IoT-based system to measure thermalinsulation efficiency. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02459-0

Al-Baltah IA, Ghani AAA, Al-Gomaei GM, Abdulrazzak FAH, Kharusi AAA (2020) A scalable semantic data fusion framework for heterogeneous sensors data. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02527-5

Alipio MI Peñalosa KMT, Unida JRC (2020) In-store customer traffic and path monitoring in small-scale supermarket using UWB-based localization and SSD-based detection. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02236-z

Aswathy RH, Malarvizhi N (2021) A design of lightweight ECC based cryptographic algorithm coupled with linear congruential method for resource constraint area in IoT. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02788-0

Bhatia M, Kaur S, Sood SK (2020a) IoT-inspired smart home based urine infection prediction. J Ambient Intell Human Comput, pp 1–15. https://doi.org/10.1007/s12652-020-01952-w

Bhatia M, Sood S, Sood V (2020b) A novel quantum-inspired solution for high-performance energy-efficient data acquisition from IoT networks. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02494-x

Đuric I, Barac D, Bogdanovic Z, Labus A, Radenkovic B (2021) Model of an intelligent smart home system based on ambient intelligence and user profiling. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-021-03081-4

Farahbakhsh F, Shahidinejad A, Ghobaei-Arani M (2021) Context-aware computation offloading for mobile edge computing. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-021-03030-1

Fazel E, Shayan A, Mahmoudi Maymand M (2022) Designing a model for the usability of fog computing on the internet of things. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-021-03501-5

Gheisari M, Javadpour A, Gao J, Abbasi AA, Pham QV, Liu Y (2022) PPDMIT: a lightweight architecture for privacy-preserving data aggregation in the Internet of Things. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-022-03866-1

Hosseinzadeh M, Koohpayehzadeh J, Ghafour MY, Ahmed AM, Asghari P, Souri A, Pourasghari H, Rezapour A (2020) An elderly health monitoring system based on biological and behavioral indicators in internet of things. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02579-7

Javed AR, Beg MO, Asim M, Baker T, Al-Bayatti AH (2020) Alphalogger: detecting motion-based side-channel attack using smartphone keystrokes. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-01770-0

Kaur A, Bhatia M (2021) Stochastic game network based model for disaster management in smart industry. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-021-03090-3

Kumar D, Jain S, Khan A, Pathak PS (2020) An improved lightweight anonymous user authenticated session key exchange scheme for Internet of Things. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02532-8

Li Q, Ning H, Mao L, Chen L (2020) Using model's temporal features and hierarchical structure for similar activity recognition. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02035-6

Lu CH, Liu CH, Chen ZH (2020) Secure and efficient firmware update for increasing IoT-enabled smart devices. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02492-z

Manocha A, Kumar G, Bhatia M, Sharma A (2021) IoT-inspired machine learning-assisted sedentary behavior analysis in smart healthcare industry. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-021-03371-x

Nawi NC, Al Mamun A, Md Nasir NA, Rahman MK (2022) Analyzing customer acceptance of the internet of things (IoT) in the retail industry. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-022-04383-x

Pignaton de Freitas E, Olszewska JI, Carbonera JL, Fiorini SR, Khamis A, Ragavan SV, Barreto ME, Prestes E, Habib MK, Redfield S, Chibani A (2020) Ontological concepts for information sharing in cloud robotics. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02150-4.

Poonia RC, Bhatnagar V (2022) Design of decision support system to identify crop water need. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-021-03291-w

Saleemi M, Anjum M, Rehman M (2020) Ubiquitous healthcare: A systematic mapping study. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02513-x

Shahra EQ, Wu W (2020) Water contaminants detection using sensor placement approach in smart water networks. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02262-x

Tomazzoli C, Scannapieco S, Cristani M (2020) Internet of things and artificial intelligence enable energy efficiency. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02151-3

Urkude G, Pandey M (2021) Contextual triple inference using a semantic reasoner rule to reduce the weight of semantically annotated data on fail–safe gateway for WSN. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02836-9

Wu S, Austin AC, Ivoghlian A, Bisht A, Wang KIK (2020) Long range wide area network for agricultural wireless underground sensor networks. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02137-1

Zgheib R, Kristiansen S, Conchon E, Plageman T, Goebel V, Bastide R (2020) A scalable semantic framework for IoT healthcare applications. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02136-2

Zhu W, Li Y, Li S, Xu Y, Cui X (2020) Optimal bandwidth allocation for web crawler systems with time constraints. J Ambient Intell Human Comput. https://doi.org/10.1007/s12652-020-02377-1

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