Editorial

Software Architectures for Context-Aware Smart Systems

This special issue on software architectures for context-aware smart systems aims to outline the importance of the architectural aspects in the development of context-aware solutions, and their role in ensuring and improving the overall quality of the software in different smart systems domains based on the enabling technologies, such as the Internet-of-Things (IoT).

Context-aware solutions are "aware" at run-time of their execution and communication environment. They exploit this awareness to adapt the structure and the behavior of the applications and of the underpinning platforms (e.g., the middleware or the communication networking infrastructure) *predictively* and *reactively* to the context. It also means that *smart and autonomous services* are provided, which meet the evolving users' needs and ensure the required and expected quality levels. In *context-aware smart systems*, the decision process about reactions to *events* tends to move from design-time to run-time, where the context plays a key role in the system behavior and needs to be understood and reacted upon dynamically Software is hence expected to make wise use of the *knowledge* about its context at run-time.

The size and complexity of context-aware smart software are increasing every day. Thus, software asks for innovative and enhanced software engineering, maintenance, testing and evaluation approaches. Practices tend to address the continuously changing requirements and expectations of the IT and business world, as well as the evolution of the available solutions. Under these premises, the *software architecture* is central in that it defines the basic blocks able to ensure the quality attributes of the system at run-time.

The objective of this Special Issue is to include papers whose topics aim at identifying and describing from an architectural perspective the issues and challenges raised by the development and the evolution of software systems that are: context-aware, dynamic, distributed, autonomous, smart, adaptive, mobility-enabled, and self-managed. The issues discussed in the papers in general tackle how the software architecture establishes the fundamentals and the rules for the interaction, integration, communication, observation, and control aspects to be addressed during the software development and maintenance cycle.

This Special Issue contains four papers whose contents can be summarized as follows.

The first paper is entitled *"State of the art in Hybrid Strategies for Context Reasoning: A Systematic Literature Review"* and is authored by Roger Machado, Ricardo Almeida, Ana Marilza Pernasa, and Adenauer Yamin. It provides the state of the art elements that allow for identifying and studying *hybrid methods* for context reasoning upon IoT data. The survey considers papers published between 2004 and 2018. The search engines have returned 3241 papers related to this topic. Ten of these papers are described and compared based on the acquisition, modeling, reason-

ing, and storage of contextual information, as well as their evaluation methodology, and the strategies used for context reasoning. The tackled subject is relevant for different actors of the IoT domain, and in general for the IT specialists operating in areas such as infrastructure and platform providing and application development, since *reasoning on IoT* data is of extreme interest for deployment in vary many different sectors.

The second paper is entitled *"An overview of a novel analysis approach for enhancing context awareness in smart environments"* and is authored by Nesrine Khabou, Ismael Bouassida Rodriguez, and Mohamed Jmaiel. It proposes an analysis approach that helps application designers in the design and the development of context-aware applications able to detect context changes and to predict their dynamic evolution. The approach is validated through a case study regarding *smart buildings* and concerns *water consumption prediction.*

The third paper is entitled *"A Distributed Event-Driven Architectural Model based on Situational Awareness applied on Internet of Things"* and is authored by Ricardo Almeida, Victor Renan Covalski Junes, Roger Machado, Diórgenes Yuri Rosa, Lucas Donato, Adenauer Yamin, and Ana Marilza Pernas. It provides an architectural model, called Execution Environment for Highly Distributed Applications - Situational Awareness (EXEHDA-SA) to support non-functional properties required by today's IoT distributed platforms and applications. Considered issues are scalability, flexibility, autonomy and heterogeneity, through a hierarchical organization and modular strategies conceived on the basis of *Situational Awareness* concepts. The model focuses on the *event* concept and its collection, normalization, contextualization, processing, actuation, and storage. The model has been validated through five case studies using free open source software.

The fourth paper is entitled *"GoalD: A Goal-Driven Deployment Framework for Dynamic and Heterogeneous Computing Environments"* and is authored by Gabriel Rodrigues, Felipe Guimarães, Genaina Rodrigues, Alessia Knauss, Raian Ali, Hugo Andrade, and Joao Paulo Costa de Araujo. The paper proposes GoalD, a goal-driven framework to support autonomous deployment of heterogeneous computational resources to fulfill requirements expressed as goals in highly heterogeneous environments. The framework provides also support to manage variability at deployment in a scalable manner. GoalD has an offline phase, which indicates the goals of a system and how they should be achieved, and an online phase, which addresses runtime issues arising during the achievements of the defined goals. This online phase exploits self-adaptive mechanisms based on automated reasoning. The framework has been validated through a case study called TAS (Tele Assistance System) in the healthcare application domain. The authors have also evaluated their solution by computing several metrics.

In summary, we believe this Special Issue brings forward relevant elements in the area of software engineering and methodologies in that context-awareness will continue to constitute a necessary topic to be tackled when developing smart systems, also in the area of social computing and awareness, in the more technical fields of deployment of applications on cloud/fog/edge platforms and also considering the growing plateau of stakeholders and operators in the IT and business area.

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