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Instrumentation and Measurement in the Internet-of-Things

The use of sensors and actuators as a way of controlling cyber-physical systems in integrated networks of digital devices has been referred to as the Internet of Things (IoT). The term IoT became popular in the late 1990s after it came up with several technologies related to the development and automation of sensors connected to the World Wide Web. Recent developments in wireless sensor networks have driven the expansion of IoT applications in a variety of areas like in industry, home, cities and healthcare. Actually, IoT technologies offer several possibilities by providing efficient and real-time operations over the Internet. However, the integration of many standalone IoT systems over the Internet introduces many challenges that require instrumentation and measurement practice to ensure the accuracy required in the application environment. For example, the advent of Industry 4.0 intends to optimize production, which will introduce new hybrid business models and exploit smart technologies while accelerating innovation cycles. Thus, several efforts have been made in industry to seek automatic cyber-physical interconnection between the virtual and physical worlds by linking the data acquired from the shop floor to manufacturing execution systems.

This special issue brings a set of papers contributing to the advances in the state of the art and application in some of the main aspects related to research and development in measurement and instrumentation in the IoT. A novel framework that contributes for faster and more precise implementation of IoT solutions is proposed on self-test of high-speed Analog-to-Digital converters. As well, a new collaborative IoT-gateway architecture is suggested in support of more reliable and cost-effective measurements. The adoption of the new technologies 5G IoT is discussed, contributing for a visionary new era of communications and measurements in IoT. In the application domain, a smart pen-shaped digital multimeter system based on IoT and cloud is suggested, and a case study is presented and discussed on contaminants detection and classification through a customized IoT-based platform. A survey on supportive IoT technologies for people with dementia is described, together with analytics of data ingested in fog context setting. A remote laboratory design and implementation as a measurement and automation experiential learning opportunity is proposed. The final paper proposes a methodology and its associated software to support satellite functional testing.

Some of the promising research directions on this cutting-edge topic provide further possible directions to be addressed, as well as discoveries to create competitive technological innovation for digital engineering. Hence, instrumentation and measurement in the IoT domain require efficient mechanisms with a unified view of precision properties that must be preferably applied in advance to ensure the reliable use of sensors and actuators in IoT enabled networks. Such future trends have the potential to address precision concerns, which is one of the most important aspects of a full IoT adoption. Although digital platforms are comprised of technologies incorporating components directly related to IoT, such as 5G, edge computing, IoT and low cost communication, these technologies will create more unpredictable and disruptive advances for humans, where instrumentation and measurement must once again be challenged. They will allow the gap to be filled between the precision of electronic devices and the accuracy of the data in very truthful integrated networks of digital devices able to provide awareness by the use of applications on top of the data received from the physical world.