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Editorial

Open-Source Electronics Platforms: Development and Applications

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1. Introduction

Open-source electronics are becoming very popular with our daily educational and developmental purposes. Currently, using open-source electronics for teaching Science, Technology, Engineering and Mathematics (STEM) is becoming the global trend. Off-the-shelf embedded electronics such as Arduino- and Raspberry-compatible modules have been widely used for various applications, from Do-It-Yourself (DIY) to industrial projects. In addition to the growth of open-source software platforms, open-source electronics play an important role in narrowing the gap between prototyping and product development. Indeed, the technological and social impacts of open-source electronics in teaching, research and innovation have been widely recognized.

2. Summary of the Special Issue

This Special Issue is a collection of 11 technical papers and one review article selected through the peer-review process. This collection represents the diversity, as well as the impact of open-source electronics through numerous system developments and applications. The contributions in this Special Issue can be summarized as follows.

Trilles et al. [1] developed an Internet of Things (IoT)-based sensor node, named SEnviro, for smart agriculture. The wireless sensor node resulted in the integration of temperature, air humidity, barometer, soil moisture and weather sensors, as well as a 3G wireless communication module and a sonar panel. A state machine-based software platform consisting of logic control, basic configuration, communication and energy consumption modules was implemented to govern the behavioural operations of the nodes. The wireless sensor nodes were deployed and tested with the application of monitoring and detecting diseases in vineyards.

Similarly, Zhang et al. [2] presented a platform for real-time data transmission and analysis of livestock. The platform is an integration of wireless sensor nodes mounted on livestock and repeaters for data relay and processing. The developed system was deployed and examined with the process of feeding and breeding management in grazing in the real field.

Hang et al. [3] proposed a sensor cloud-based platform that is capable of virtually representing physical sensors in the Cloud of Things (CoT) environment. The design and implementation procedures of the sensor-cloud platform governing different types of wireless sensor nodes with faulty sensor detection capability were addressed and verified through comparison analysis with existing systems.

Kashevnick et al. [4] proposed an ontological approach of blockchain-based coalition formation for Cyber-Physical Systems (CPS). A model of abstract and operational context management for the interaction and ontology of multi-agent cyber-physical systems was developed and evaluated through the collaboration of a heterogeneous system of mobile robots.

Rooney et al. [5] presented a method of hardware trojan creation and detection using FPGAs and off-the-shelf components. They demonstrated that by using off-the-shelf components, they were able to reduce the cost of integrated circuit design and fabrication for trojan detection in different settings.

Ferrari et al. [6] proposed an experimental methodology of examining the impact of Quality of Service (QoS) on the communication delay between the production line and the cloud platforms using the Open Platform Communication Unified Architecture (OPC UA) gateways. The experiment results of measuring the overall time delay between a machine with an OPC UA interface and a cloud platform demonstrated the impact of the QoS parameters on the communication delay, which is an important factor to guarantee real-time processing of industrial IoTs.

Merenda et al. [7] presented the design and implementation of smart converters for metering and testing the current and voltage of renewable energy systems. Using smart converters, a developer can focus on developing software algorithms for controlling and managing ecosystems. The key features of the developed converters such as system-level management, real-time diagnostics and on-the-fly parameter change were tested and verified with a solar simulator, as well as photovoltaic generators.

Yang et al. [8] developed a single-channel bio-signal-based Human–Computer Interface (HCIs) to estimate the horizontal position of the eyeballs of disabled people. Input signals from Electrooculograms (EOG) and Electromyograms (EMG) were processed in real-time through a modified sliding window algorithm using Piecewise Linear Approximation (PLA), and the eyeball position was identified through the curve-fitting model using the Support Vector Regression (SVR) method. The advantages of the proposed method were evaluated in comparison with the conventional EOG-based HCI.

Ariza [9] presented an open-source hardware and software platform for learning embedded system, named DSCBlocks. Using algorithm visualizations with the graphical building block of embedded C codes for dsPIC, a learner can focus on designing an algorithm to program digital signal controllers and observe the configuration at the hardware level.

In a similar way, Ngo et al. [10] introduced an open platform for the multi-disciplinary teaching methodology in terms of Problem Base Learning (PBL) and the Engineering Projects in Community Service course (EPICS) for engineering students. The open platform is a low-cost automated guided vehicle built of off-the-shelf components including the ARM Cortex M4 32-bit, a WiFi module, proximity sensors, a camera, cylinders and equipped with open-source libraries. It was demonstrated and surveyed that the open platform has been productively used for students in mechatronics, computer science and mechanics in their collaborative projects.

In addition, Vega et al. [11] introduced an open low-cost robotics platform, named PiBot, for STEM education. The platform was developed by the integration of off-the-shelf components including the Raspberry Pi 3 controller board, the Raspberry PiCamera, n ultrasonic sensor, infrared ranging sensors and motor encoders under the Do-It-Yourself (DIY) philosophy. A simulated robot under the Gazebo simulator was also developed to provide an alternative learning platform for students. The robotic platforms were examined and evaluated through a series of exercises of robot programming, control and vision.

Lastly, Costa et al. [12] provided a comprehensive review of open-source electronics platforms as enabling technologies for smart cities. The key features including the advantages and disadvantages of using off-the-shelf electronics and computing boards, e.g., Raspberry Pi, BeagleBoard and Arduino, and open-source software platforms, Arduino and Raspbian OS, were discussed through numerous smart-city applications.

The diversity of open-source electronic platforms, as well as their applications presented in this collection [1–12] demonstrates that there is no restriction nor limitation in using open-source electronics for education, research and product development. We are delighted to offer this Special Issue in order to deliver up-to-date knowledge and technology of open-source electronics to our readers. In particular, we believe that this Special Issue can be a good reference for engineering and science students in their education and research activities.

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