World Academy of Science, Engineering and Technology
International Journal of Information and Communication Engineering
Vol:16, No:12, 2022

Bluetooth Communication Protocol Study for Multi-Sensor Applications

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Abstract : Bluetooth Low Energy (BLE) has emerged as one of the main wireless communication technologies used in low-power electronics, such as wearables, beacons, and Internet of Things (IoT) devices. BLE's energy efficiency characteristic, smart mobiles interoperability, and Over the Air (OTA) capabilities are essential features for ultralow-power devices, which are usually designed with size and cost constraints. Most current research regarding the power analysis of BLE devices focuses on the theoretical aspects of the advertising and scanning cycles, with most results being presented in the form of mathematical models and computer software simulations. Such computer modeling and simulations are important for the comprehension of the technology, but hardware measurement is essential for the understanding of how BLE devices behave in real operation. In addition, recent literature focuses mostly on the BLE technology, leaving possible applications and its analysis out of scope. In this paper, a coin cell battery-powered BLE Data Acquisition Device, with a 4-in-1 sensor and one accelerometer, is proposed and evaluated with respect to its Power Consumption. First, evaluations of the device in advertising mode with the sensors turned off completely, followed by the power analysis when each of the sensors is individually turned on and data is being transmitted, and concluding with the power consumption evaluation when both sensors are on and respectively broadcasting the data to a mobile phone. The results presented in this paper are real-time measurements of the electrical current consumption of the BLE device, where the energy levels that are demonstrated are matched to the BLE behavior and sensor activity.

Keywords : bluetooth low energy, power analysis, BLE advertising cycle, wireless sensor node
Conference Title : ICDCN 2022 : International Conference on Digital Communication and Networks
Conference Location : New York, United States
Conference Dates : December 09-10, 2022