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ZigBee Wireless Sensor Nodes with Hybrid Energy Storage System Based on Li-Ion Battery and Solar Energy Supply

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Abstract : Most ZigBee sensor networks to date make use of nodes with limited processing, communication, and energy capabilities. Energy consumption is of great importance in wireless sensor applications as their nodes are commonly battery-driven. Once ZigBee nodes are deployed outdoors, limited power may make a sensor network useless before its purpose is complete. At present, there are two strategies for long node and network lifetime. The first strategy is saving energy as much as possible. The energy consumption will be minimized through switching the node from active mode to sleep mode and routing protocol with ultra-low energy consumption. The second strategy is to evaluate the energy consumption of sensor applications as accurately as possible. Erroneous energy model may render a ZigBee sensor network useless before changing batteries. In this paper, we present a ZigBee wireless sensor node with four key modules: a processing and radio unit, an energy harvesting unit, an energy storage unit, and a sensor unit. The processing unit uses CC2530 for controlling the sensor, carrying out routing protocol, and performing wireless communication with other nodes. The harvesting unit uses a 2W solar panel to provide lasting energy for the node. The storage unit consists of a rechargeable 1200 mAh Li-ion battery and a battery charger using a constant-current/constant-voltage algorithm. Our solution to extend node lifetime is implemented. Finally, a long-term sensor network test is used to exhibit the functionality of the solar powered system.

Keywords : ZigBee, Li-ion battery, solar panel, CC2530
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