

Eco: an Ultra-Compact Low-Power Wireless Sensor Node for Real-Time Motion Monitoring

Chulsung Park, Jinfeng Liu, and Pai H. Chou
Center for Embedded Computer Systems
University of California, Irvine, CA 92697-2625 USA
{chulsung, jinfengl, phchou}@uci.edu

1 Introduction

Eco is a wireless sensor network for monitoring the movement of distributed objects. Currently, Eco is configured for a medical application to monitor the spontaneous movement of pre-term infant babies. As show Fig. ??, Eco node measures $12 \times 12 \times 4.5 \text{ mm}^3$ in volume and it weighs under 1.6 grams. The compact form factor, low power consumption and flexibility make Eco node applicable to a variety of wireless sensor applications ranging from medical studies, environmental monitoring, new computer-human interface and ambient intelligence.

2 Design

Each Eco sensor node captures tri-axis acceleration (by H48C from Hitachi Metals) with the 12-bit precision of a 9-channel ADC. The motion data is then transmitted to the Eco Station through the nRF24E1 2.4GHz RF transceiver. With the integrated 8051 controller, the nRF24E1 can be programmed to operate at 125 different frequency channels and its transmission data rate can be set to 250Kbps or 1Mbps. Currently the Eco sensor can be attached with two types of batteries: Li-Coin (CR2025,170mAh) and Li-Polymer(12x12x5mm, 40mAh). The feature enables Eco to be applied to a variety of applications with different requirements on data rates, response time and duty cycles.

The Eco Station is designed using a Freescale's MC9S12NE64 and a nRF2401 RF transceiver. The MC9S12NE64 is programmed to communication with four Eco nodes through a TDMA scheme. The received acceleration data are sent to a host computer through a Fast Ethernet integrated on the MC9s12NE64.

3 Demonstration

The setup of the demo will include four Eco sensor nodes, one Eco Station and the host computer. Each Eco node transmits to the Eco Station at 2.4GHz through a TDMA protocol. The synchronization for TDMA is performed during a setup period when the Eco Station broadcasts synchronization packets to all Eco nodes. After synchronization is com-

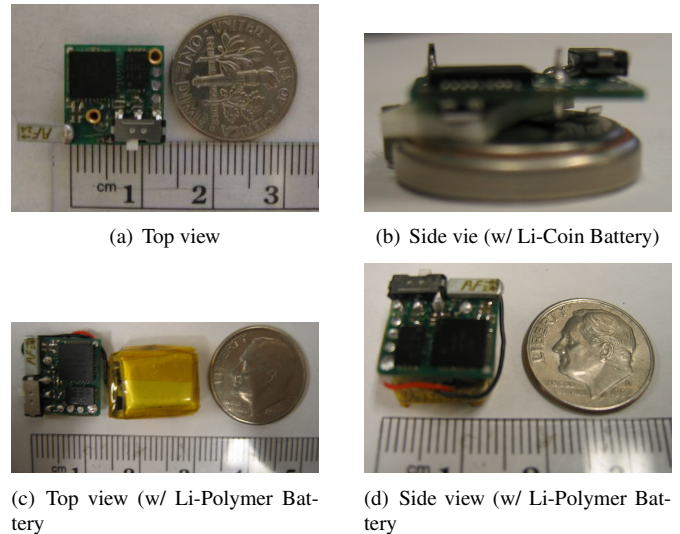


Figure 1: Photo of Eco

pleted, each Eco node start sampling acceleration data and transmitting them to the Eco Station. The Eco Station constructs the incoming data into TCP packets to be sent to the host computer via the Ethernet port. The GUI program on the host computer will display the motion data from four Eco nodes in real-time.