DESIGN OF A GENERAL PURPOSE MULTI-CHANNEL WIRELESS DATA ACQUISITION SYSTEM

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INTRODUCTION
Wearable wireless systems are used in many of today’s laboratories to acquire biological or sensor data. However, many of these systems cater to one type of sensor, record from a limited number of channels, occupy USB ports, and are expensive. Here, we describe a novel, low-cost wireless data transmission system that can be used with any Bluetooth-enabled computer running Matlab. This device provides an inexpensive and reliable means of streaming data from multiple for collection and analysis. The primary motivation for the development of this device was to quantify dexterity using the strength-dexterity paradigm [1], however, this device finds applications in countless areas of research.

METHODS

Device and telemetry details
Up to 16 various types of sensors can be sampled using this device. All inputs are low-pass filtered and digitized with 12 bits of resolution using a PIC microcontroller. To ensure that each channel is correctly decoded, every sample is prepended with a 4-bit address. The Bluetooth module (RN-41, Roving Networks), which allows for wireless transmission, has a baud rate of 921,600 bps. Since all channels in use must share this bandwidth, the maximal sampling frequency per channel given by f_{max}=46080/N (Hz/channel), where N is the number of channels being used. According to this formula, the maximal sampling rate is 46 kHz for a single sensor and 2.88 kHz when sampling from 16 sensors. The circuit board (Fig.1) is housed within a rectangular enclosure measuring 5.08 x 5.84 x 1.27 cm, making the device smaller than most cell phones.

RESULTS
Fig. 2 shows sample data collected from two types of sensors data sampled at 400 Hz for approximately 20 seconds. The top figure shows forces applied to a compressible spring squeezed between the thumb and forefinger. Sudden drops in the figure indicate when finger contact was lost due to spring buckling. The bottom figure shows the sum of x, y and z accelerations from accelerometers placed on the thumb and index finger during the spring compression task. This data shows that it is possible to capture rapid dynamical changes when collecting data from various sensors. All data were collected using a PC laptop running Windows 7.

Figure 2: Sample data collected from device.

DISCUSSION & CONCLUSIONS
Overall, the device is easy to use, wearable, low power and low cost. Within a few minutes, users can begin capturing and viewing data. Although the device was created to capture data or a specific purpose, it can be tailored to collect analog data from a wide variety of sensors and electrodes, including signals with high bandwidths, such as EMG. Currently, the user interface is being updated to increase user capabilities and provide a more aesthetic appearance.

Potential clinical uses for this system include data capture for strength-dexterity testing, quantification of dexterity in children and elderly, a means of providing inputs to controllers for rehabilitation gaming, and validation of treatments for individuals with neurological disorders affecting dexterity and manipulation.

REFERENCES

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