MousePaak – A Rodent Radio For Neurological Studies

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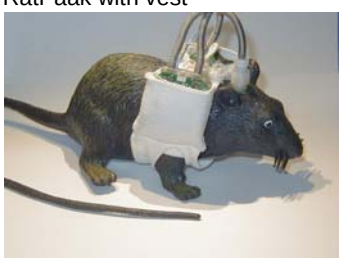
Abstract

The aim of this project is to develop a physiological wireless monitoring device that is small enough to be worn by a mouse. This device will allow behavior to be observed and physiological parameters to be measured without tethering the mouse as is traditionally required. The Phase I of this program developed a small, two channel wireless physiological monitor transmitter that allow EEG, EKG, EMG and other physiological parameters of rats and other small animals to be measured by researchers. In Phase II, the transmitter is being shrunk to allow it to be used for developing rats or mouse environments. The transmitter will have sufficient range to allow the animal to freely move about their environment, which will allow for free maze studies, and even mazes that include navigating through water. Testing on the RatPaak will be continued at Johns Hopkins during the Phase II as well as testing on the newly developed MousePaak.

Introduction

During the Phase I, we developed a rodent radio called the "RatPaak®". The RatPaak is a two-channel data acquisition transmitter device used to monitor electroencephalogram (EEG), electromyogram (EMG), electrocardiogram (ECG), or electrooculogram (EOG). The device is designed to fit into "saddlebags" on a vest worn by a rat. The transmitter is on one side and the batteries on the other. Three hearing aid batteries power the device for 24 hours.

RatPaak with vest

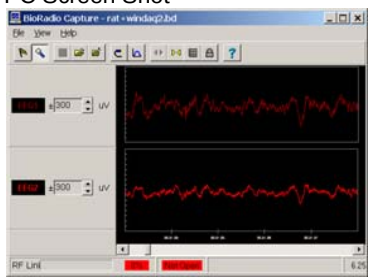


BioCapture Software

The RatPaak collects signals from wires attached to the subject, performs analog-to-digital conversion, encoding, formatting, and transmitting of all signals. The signals are communicated using a 902-928 MHz radio transmitter. Over one hundred transmitters can be used in the same area without interference with one another. The receiver assembly receives the transmitted data packets, performs extensive error detection and correction, and then sends the data through a receiver cable to the PC Operator interface where data can be stored, monitored in real time, or analyzed at a later time.

Receiver

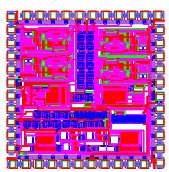
PC Screen Shot



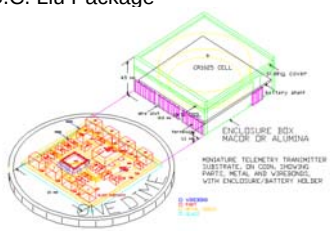
Sponsored Research

We plan to enhance the performance of the system developed at CWRU by reducing the power requirements, developing a multi-channel receiver and reducing the cost of the system.

ASIC Design

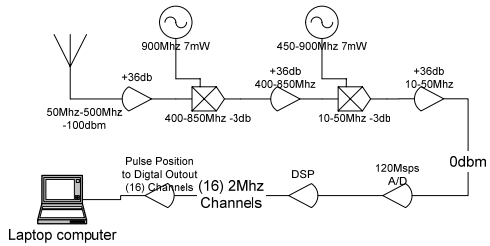


C.C. Liu Package



Multi-Channel Receiver

A pulse position modulation topology was used for a low energy per bit design. The fundamental idea is to send short pulses at various frequencies, and detect their position with respect to the relative time between pulses. The demodulation and demultiplexing of sixteen transmitters can be efficiently processed by using matched filters in a digital signal processor (DSP). The DSP also allows us to track the sixteen individual transmitters and demodulate the information in spite of drift and distortion produced by low power, low cost, relatively simple transmitters.



MousePaak Transmitter

We have made the MousePaak smaller, more compact and less expensive to manufacture. The ASIC is mounted on a standard printed circuit board and the enclosure (plastic cap) is a plastic injection part. The antenna coil is incorporated into the plastic cap. The battery is replaceable by "unsnapping" the 12 mm diameter plastic cap.

MousePaak Design

Acknowledgements

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