Demo Abstract: A Hybrid Sensor Network for Cane-toad Monitoring

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ABSTRACT

This demonstration shows a wireless, acoustic sensor network application — monitoring amphibian populations in the monsoonal woodlands of northern Australia. Our system uses automatic recognition of animal vocalizations to census the populations of native frogs and the invasive introduced species, the Cane Toad (see Fig. 1). This is a challenging application because it requires high frequency acoustic sampling, complex signal processing and wide area sensing coverage [2]. Our prototype consists of a *hybrid* mixture of Stargates and inexpensive, resource-poor Mica motes operating in concert. The Mica motes are used to collect acoustic samples, and expand the sensor network coverage. The Stargates are used for resource-intensive tasks.

Categories and Subject Descriptors: C.2[Computer Systems Organization]:Computer Communication Networks

General Terms: Measurement, Design, Experimentation

Keywords: Sensor Networks, Hybrid, Application

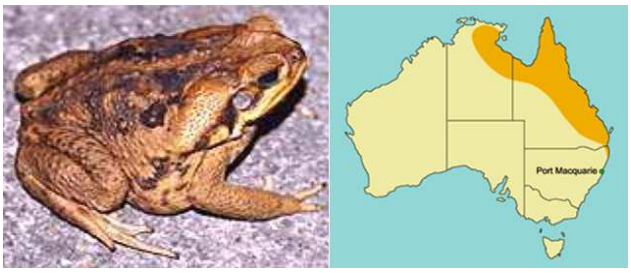

Figure 1: The Cane Toad and its 2003 Australian distribution.

1. DEMONSTRATION OVERVIEW

In this demonstration, we will show how a hybrid sensor network can be used to monitor amphibian populations, using automatic recognition of animal vocalizations, to detect up to 9 frog species found in northern Australia. The impetus for developing such a network has been the cane toad's progressive spreading (see Fig. 1) in Australia.

The hybrid sensor network consists of two devices, namely, Crossbow Stargates and Mica motes. A Mica mote collects acoustic samples (at 10KHz) from the environment, and performs pre-processing (compression, noise reduction) before transferring them to a Stargate. High-rate sampling is achieved by exploiting the redundancy of Mica sensors via sampling scheduling. After receiving the acoustic samples, the Stargate generates a sound spectrogram, using a Fast Fourier Transform algorithm, from the original acoustic signal. The sound attributes, including local peaks and other necessary variables, are extracted from the spectrogram, and used as the input of the machine learning process. If the input attributes can match one or more pre-computed species classifiers, one or more species are identified. To increase correctness and reliability of the recognition, a hierarchical voting process is employed.

This demonstration is intended to showcase both a real-world sensor technology application [1] as well as the potential of hybrid sensor network architectures. We show that a complicated acoustic monitoring task requiring high rate sampling and complex signal processing can in fact be implemented by an inexpensive hybrid sensor network architecture via careful allocation of tasks among motes and Stargates, and by exploiting redundancy among multiple motes.

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3. REFERENCES

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SenSys'05, November 2–4, 2005, San Diego, California, USA.
ACM 1-59593-054-X/05/0011.