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# Coastal Underwater Field Observer with Remote IP Access

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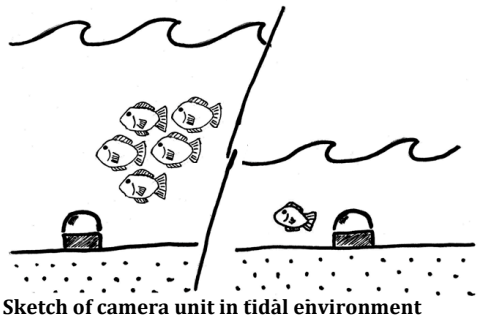
Wireless sensor networks target a variety of ecological monitoring applications that require long-term unattended operation using batteries and/or energy harvesting. These systems typically measure, log, and disseminate point measurements within scant energy budgets consistent with low-cost widespread deployment. In contrast, video observations can be virtually continuous in time, require sustained energy consumption, and require expensive network resources while active. Our work on this problem is toward localizing the intelligence of the video observation, reduction of the data transmission cost, and increasing the utility of the video information product. We currently exploit IP-based video cameras that are inexpensive and adaptable to our applications.

**Gray seals – one of many possible marine studies**

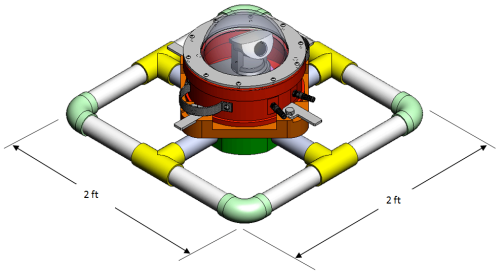
In the following we describe recent work in the development of two complementary components of our evolving ecological observation platform. The first is an underwater camera unit containing an IP-based PTZ camera intended for tidal-depth underwater observation including fish counting. The second component is a portable networking 'cart' providing a remote gateway function for powering the underwater camera and serving as a hub for additional untethered wireless IP video cameras. The network hub includes a wireless directional bridge for linking to the Internet and is implemented using low-cost consumer networking components.



**Sketch of camera unit in tidal environment**

## Underwater Camera Unit

We designed an underwater housing (right) for the purpose of enabling video observations in estuaries. This camera is tethered with both power and network cabling. Critical design requirements were (1) the need to protect the camera from seawater, (2) stability under current or wave




**CAD rendering of underwater camera housing**

activity, (3) serviceability, and (4) capability for being externally powered. The camera is intended for lateral or upward views and thus rests on the estuary floor. Depth of operation is assumed to be less than 10m although considerable margin was built into the design. Illustrated here are a schematic of the camera unit including removable anchor, enclosure housing, and acrylic lens. The enclosure body is designed to attach to an anchor mounting plate and thus provides flexibility in anchor type for different bottom types or use in fish ladder installations.

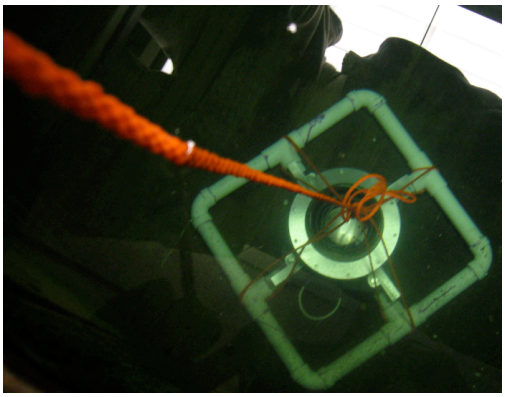
**Networking Cart for Remote Access**

The second component of our system is a remote access point configured as a cart to allow deployment at various locations in the vicinity of observation. Key design requirements for the cart in support of video monitoring, logging, and analysis are (1) sufficient energy capacity and replenishment for daily (daylight) operation, (2) wireless access for connecting to wireless camera mesh, (3) sufficient data bandwidth for recording of continuous video to local storage, (4) remotely accessible to provide remote observation and diagnostic feedback, and (5) easy to deploy and use.

**Remote access point (configured as cart)**

The cart has been assembled using commodity IP networking components including wireless router and wireless bridge. We used Linksys components (WRT54GL) that are reprogrammable with open-source software (Tomato) for more flexible configuration and management.

Both the cart and the underwater camera unit will be deployed at the University of Massachusetts Field station at Nantucket Massachusetts in August 2009. We anticipate facilitating use of the camera as part of outreach activities at the Field Station and in supporting research of Field Station visitors and staff.



**Prototype testing – High tide simulation 2.5m**

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