

CSE 4/60373: Multimedia Systems

- ▶ Outline for today
 - Video sensors

- ▶ **Sensor networking is a hot research topic: goal is to monitor environments using inexpensive sensing devices**
 - E.g. monitor battle fields to search for tanks using sound, vibrations etc.
 - Watch:
 - http://wbc.who.edu:8060/http/WHOI_CMS/News/PA821.mov



Video sensing from Nova (two weeks back)

- ▶ <http://www.pbs.org/wgbh/nova/extremeice/>
- ▶ <http://www.pbs.org/wgbh/nova/extremeice/melt-flash.html>
- ▶ **Extreme Ice Survey**
 - <http://www.extremeicesurvey.org/index.php/about/>
 - EIS cameras are programmed to shoot once an hour, every hour of daylight, indefinitely. Each camera captures approximately 4,000 images per year for a total projected archive of nearly 500,000 photographs by completion of the survey. The time-lapse images will be edited into video that reveals how fast climate change is transforming large regions of our planet.
 - Video: <http://www.extremeicesurvey.org/index.php>



EIS equipment

- ▶ EIS camera setups must withstand winds as strong as 160 mph, temperatures as low as -40°F, blizzards, landslides, torrential rain, and avalanches. The Extreme Ice Survey uses Nikon D-200 digital single-lens reflex cameras powered by a custom-made combination of solar panels, batteries, and other electronics. The cameras are protected by waterproof and dustproof Pelican cases, mounted on Bogen tripod heads, and secured against arctic and alpine winds by a complex system of anchors and guy wires. Each configuration weights 70 pounds or more.



Panoptes

- ▶ Feng, W., Kaiser, E., Feng, W. C., and Baillif, M. L.
Panoptes: scalable low-power video sensor networking technologies
 - Built a video sensor platform
 - Experiences in encoding video, power management, programming and controlling those video camera
 - 400 MHz Xscale platform



Challenges:

- ▶ How to physically build these things and deploy them. Video sensors need to be clean. For example, Panopte monitors Oregon coast. Need to worry about misting, gunk, bird dropping etc. Not always possible to go clean them every day
 - Maintaining is a problem. Oregon coast is fairly long. If things break, then have to send a student up and down the coast. Assuming 1500 camera for the entire coast, you would probably spend all your time cleaning and fixing gear
 - Energy is a concern but not much. Wind is plentiful though wind-vanes can be a bird killer. Birds may also sit on those vanes!! Solar energy is not a viable option because of bird droppings!!



Challenges

- ▶ How do we get data from the sensor to the main board
 - Perhaps integrate them directly onto the motherboard PCI or some such bus
 - Use PCMCIA or some such interface
 - Highly energy inefficient
 - Use Firewire or USB 2.0 (operates at 400 MHz and 480 MHz respectively). Requires CPU power to consume this data
 - Use USB 1.1 (12 Mbps theoretical max)
 - Cameras compress objects. Require software to decompress them and then recompress them
 - Panopte uses JPEG because MPEG was too CPU intensive
 - Hardware MPEG encoder will be nice. The VIA board only has a decoder to play DVD/HDTV etc



Buffer management

▶ Once captured:

- we could stream all objects in real time. Makes sensors simple but requires good and continuous network availability
 - Requires massive infrastructure. Imaging streaming video from 1300 camera to a central site for processing
- Preprocess, buffer and only transmit some information
 - Preprocessing should be flexible. We may require good quality when we are interested in some event
 - Buffer management is important because buffer space is finite, have to decide reclamation policy
 - Could transcode some objects to save space



Adaptive functionality

- ▶ One can build sensors that are static and keep performing the same task
 - Interesting applications require flexibility. For example, the events of interest might change. Require a flexible programming, debugging interface that can manage lots of embedded platforms
 - Panopte uses a Python based platform that allows for reconfiguring the sensors on the fly



User interface

- ▶ How would you show the video to the users?
 - How do you filter to show the objects of interest?
 - Panopte lets users specify regions of interest

