

Ivy – A Sensor Network Infrastructure for the College of Engineering

A sensor network, that like ivy, spreads through the environment and links leaves to the root



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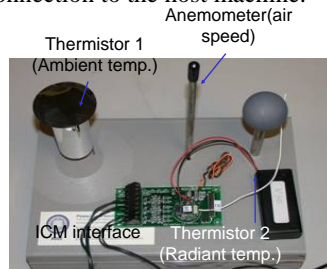
Project Goals

- Research infrastructure of networked sensors
- A lifetime of several months on 1 lithium battery or 2 AA batteries
- Support multiple applications simultaneously

Wireless ICM sensor

- ICM (Indoor Climate Monitoring) sensor box
 - Measures air speed, ambient / radiant temperature and is made by Professor Ed Arens group.
 - Restricted monitoring capability due to the limited memory capacity and lack of constant connection to the host machine.

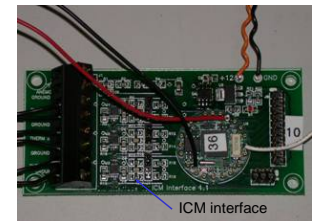
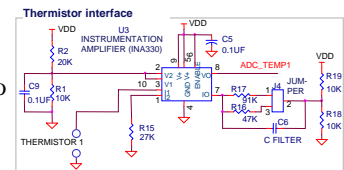
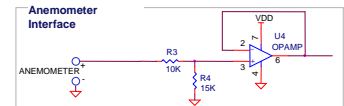
- Wireless ICM
 - We made an ICM interface board to bridge an ICM sensor box and a mica2dot mote.
 - Will provide online monitoring and large storage capability.



An ICM sensor box

ICM interface

- An ICM interface converts
 - One anemometer reading (0 – 5V) to voltage input (at most 3.3 V).
 - Three thermistor readings (58K to 18KΩ for 10 – 37°C) to voltage inputs.
 - For a temperature sensor, two temperature range can be selected (10 – 40°C or 18 – 30°C) as a trade-off of long range and accuracy.
- Voltage outputs from ICM interface are fed to a mote as ADC inputs.



Sensor calibration

- Rationale for Calibration
 - Mapping ADC readings to meaningful number.
 - ADC variation: Each mote and channel measures the same input voltage with some variance (Fig. 1).
 - Non-linearity of temperature – voltage reading: Difficult to fit a voltage reading to the temperature with a single formula (Fig. 2).
- Two stage calibration
 - We used two stage calibration: ADC => Vol => Air Speed / Temp.
 - Allows using motes / interface interchangeably.

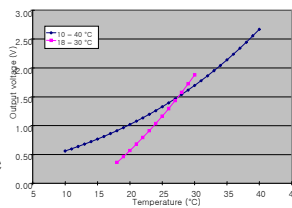


Fig. 1. Temperature reading from ICM interface

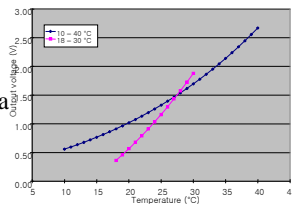


Fig. 2 Variation in ADC reading

- ADC calibration
 - Individually measured for each mote / channel.
 - Measured ADC reading for range 0.3 – 3.0V with interval 0.3V (Fig. 3).
 - Converts a given ADC reading to voltage by linear interpolation.
- Temperature calibration
 - Measured the voltage reading for range 10 – 40 °C with interval 1°C. A temperature chamber was used to set the temperature (Fig. 4).
 - Linearly interpolates voltage to temperature.

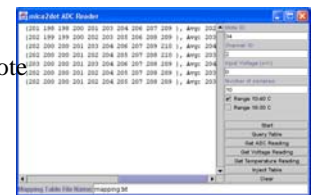


Fig. 3 ADC / Temperature Reader Application

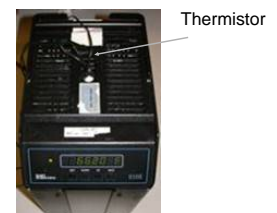


Fig. 4 Temperature Chamber

Discussion and Future Works

- Deployment for environment monitoring
 - Plan to set up the 10 – 40 wireless ICM sensors to monitor the campus environment with Professor Ed Arens group.
- The examples: Building monitoring for critical environment Comfort field study.