Networked Weather Station

EE 4390 Senior Design Project
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Sponsored by:

Texas State University

freescale semiconductor
Goals (Primary)

- Become familiar with the IoT (Internet of Things) framework and IEEE 802.15.4 (ZigBee) networking infrastructure by:
  - Collecting inputs from various weather sensors installed in the Smart Lab.
  - Aggregate, package and transmit the collected values to a central hub.
  - Store the final data in a central database.
- The final design should focus on:
  - Low energy (low power consumption) remote nodes.
  - Small size and low cost.
- Final design reports to be submitted to Freescale to be used as reference design material or as application notes.
Goals (Secondary)

- Display data from the database using analytical graphing software.
- Analyze the effects of loading the ZigBee network with a lot of sensors and traffic.
- Provide remote power source for the weather station (i.e. solar panels or batteries).
# Gap Analysis Table

<table>
<thead>
<tr>
<th>Low</th>
<th>High</th>
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<tbody>
<tr>
<td>Low</td>
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**Cost**

- High
- Low

**Networking Capability**

- High
- Low
### Snapshot

<table>
<thead>
<tr>
<th>Networked Weather Sensor</th>
<th>This project will focus on the Hardware and Networking required to complete the task. Third-party analytical software will be used for analysis.</th>
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</thead>
<tbody>
<tr>
<td>- 6 Variable Sensors</td>
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<tr>
<td>- Networked over Zigbee</td>
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<tr>
<td>- Transmits minimally</td>
<td></td>
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<tr>
<td>- Stores Raw Data in Database</td>
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### Risks

| - Power Consumption     | 1) Planning and Ordering |
| - Possibly Remote Power | 2) Programming / Assembly |
| - Packaging with Zigbee Protocol | 3) Troubleshooting / Testing |
| - Data Loss with Network Crash | 4) Custom Board Design (PCB) |
Technology Attributes & Solutions

Transmission Rate:
● Transmit at the minimum rate possible to conserve power
  ○ Transmit packets of information through Zigbee network using the existing packet protocol.

Environmental Hardening For Outdoor Environment:
● A weather resistant enclosure will be required for this device
  ○ This enclosure will have to have adequate sealed ports for the sensors.

Software to Interpret and Send Data:
● The microcontroller will be programmed to interpret sensor output to a specified degree of accuracy, and transmit it via ZigBee using the correct protocol and at a determined rate.

Power Source for Sensors and Transmitter:
● The total power consumption of the microcontroller board and all sensors will be used to determine battery capacity and possible solar charging capabilities.

Transmission Range:
● A transmitter is required that is low power, but can produce a strong enough signal to reach the database
Technology Attributes & Solutions

Our Weather Sensor will use mostly Freescale’s existing hardware to adapt to the existing weather sensors on the market.

- Low Power Consumption
- Wirelessly Networked via Zigbee
- 6 sensors
  - Temperature
  - Ambient Light
  - Barometer
  - Relative Humidity
  - Wind Speed/Direction
- Completely Stand Alone
Planning - Technology Outline

Pressure Sensor
Temperature Sensor
Wind Speed Sensor
Wind Direction Sensor
Rain Fall Sensor
Light Sensor

ADC Board
Micro-Processor Board
ZigBee Transmitter

Micro-Processor & Database
ZigBee Receiver
Planning - 2014 Schedule

Oct. 27th  In-Class Presentation Day

Oct. 29th  Project Scope & Hardware Defined
          Place Orders for Necessary Hardware
          Begin Software Development

Nov. 19th  Weather Station Physically Assembled
          Begin Software Testing / Debugging

Dec. 3rd  Prepare Hardware / Software for Presentation

Dec. 5th  Senior Project Day
Allocated Budget: \( \approx \$200 \) for non-Freescale Parts

**Freescale Parts:**
- Tower KL46Z Microprocessor Board \( \$150 \)
- Tower Elevators \( \$80 \)
- Tower Analog to Digital Converter Board \( \$120 \)
- Adapter Board \( \$45 \)
- ZigBee Radio \( \$-- \)
- Tower Prototyping Board \( \$15 \)
- Freescale Barometric Pressure Sensor \( \$15 \)

Total: \( \$425 \)

**Non-Freescale Parts:**
- Wind Speed/Direction & Rain Sensor \( \$70 \)
- Light Sensor \( \$7 \)
- Temperature Sensor \( \$2 \)

Total: \( \$79 \)

Note: Prices do not include taxes or shipping costs
Planning - Dependencies & Risks

ZigBee (IEEE 802.15.4) Networking
- Large number of sensors on network can cause interference
- Specific hardware must be used
- Transmission Distance

Remote Outdoor Weather Station
- Possible Remote Power Supply
- Weather Resistant Enclosure
- Sensor Range / Resolution / Sampling Rate

Data Transmission & Storage
- Large amount of data
- Database Structuring
- Transmission Packaging and Transmission Rate
- Data Loss