Autonomous Fire Detectors

Project Update

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Goals of Project

- Rapid development of a prototype board that can be adapted to many applications
- Development of embedded software to operate onboard devices
- Development of PC side software to extract collected data from boards
- Develop mechanical enclosures for boards for field applications
Applications

- Handheld Thermistor Logger
- Thermocouple Fire logger
- Fire Sentry
- Fire Sentry/Data Acquisition
- Lake Drifter
- Pond Monitor
- Automated Ground Truth Logger
- Air born ATV/APRS
- Lake Depth feature logger
- 1 – Wire Weather Station Logger
First Application: Handheld Logger

- Acquire precision temperature and location data
- 64 K memory = 1771 sample storage space
- Uses standard GPS unit
- PC application places data directly into Excel
Handheld Logger

- Precision Thermistor module: self contained unit accurate to 0.01°C
- Interfaces with any GPS capable of NMEA 0183 output.
- Minimal number of components on board necessary for operation
- “Off the shelf” components minimizes development time
Visual Basic Based Application

DIRS Data Logging System

Choose an Option

Download

Clear Memory

Select Communications port

Connect

Disconnect
Rugged Fire Logger

- Utilizes 4 ADC channels for thermocouple data
- RTC and Position via GPS
- Field controllable using a Palm Pilot
- Rugged NEMA enclosure suitable for hostile environments
- VB download application
Rugged Fire Logger

- 12 bit, 8 Channel ADC, 1.22mV/digital count
- Single part thermocouple amplifier with a voltage divider for level conversion
- ADC will accept input from any sensor producing output levels 0V – 5V
- 16 Pin header allows for easy implementation of a sensor daughterboard if necessary
Rugged Fire Logger

- Provides a base platform for building a fire sentry system
- Utilize other 4 ADC channels to detect other aspects of fire
- Set thresholds for alarm notification
- Add the synthesizer or modem to provide a means to alert field workers
- Utilize power management circuitry to extend battery life for longer operation
Design Methodology

- Utilized existing work done with Basic Stamp, rapid development environment
- Utilized existing choices for Thermistor, ADC, Memory and Voice Synthesizer
- Added components for power management, wireless digital data transfer & radio control
- Designed schematic for interfacing of all components
Resulting Schematic
Surface Mount Board
Full Stuffed Board
Lake Drifter

- Currently exploring packaging options with RIT ME Dept.
- Defining target sensors to be used
- Looking at pros/cons of using a moored buoy or a free-floating package
- Developing a wireless packet based protocol for remotely downloading data from the device
Wireless Communication

- Utilizing MXComm 614 modem chip
- Generates AFSK signal from simple serial data @ 1200 baud
- AFSK passed wireless via 2 meter amateur radio, can use almost any frequency radio
- AEA PK232 modem used for base station receive, may be replaced with single chip modem
- Half duplex operation allow remote control of logger
### Packet Formation

<table>
<thead>
<tr>
<th>SOH</th>
<th>SOH</th>
<th>KB2WLK</th>
<th>ID</th>
<th>ID</th>
<th>CMD…</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Start of header ($01)" /></td>
<td><img src="image" alt="Call sign for legal amateur operation (6 bytes)" /></td>
<td><img src="image" alt="Unit ID" /></td>
<td><img src="image" alt="Dest. ID" /></td>
<td><img src="image" alt="Command" /></td>
<td></td>
</tr>
</tbody>
</table>

- **SOH**: Start of header ($01)
- **KB2WLK**: Call sign for legal amateur operation (6 bytes)
- **ID**: Unit ID
- **ID**: Dest. ID
- **CMD…**: Command

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*Image of amateur radio equipment showing a display showing 144.315.*
Packet Formation

…16 bytes of data  Checksum  EOT  EOT

Data to be sent (commands, stored or live data)

Calculated for Error Correction

End of Transmission ($04)

Checksum Poly

\[ x^{16} + x^{12} + x^5 + x^0 \]
## Command Field

<table>
<thead>
<tr>
<th>Command</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Acknowledge Transmission</td>
</tr>
<tr>
<td>B</td>
<td>Dump Memory</td>
</tr>
<tr>
<td>C</td>
<td>End of Memory</td>
</tr>
<tr>
<td>D</td>
<td>clear memory</td>
</tr>
<tr>
<td>E</td>
<td>gets current latitude</td>
</tr>
<tr>
<td>F</td>
<td>gets current longitude</td>
</tr>
<tr>
<td>G</td>
<td>gets the current time</td>
</tr>
<tr>
<td>H</td>
<td>gets the current date</td>
</tr>
<tr>
<td>I</td>
<td>gets the value for specified AD channel in data field</td>
</tr>
<tr>
<td>J</td>
<td>gets the value for the thermistor</td>
</tr>
<tr>
<td>K</td>
<td>indicates there is data in the data field</td>
</tr>
<tr>
<td>L</td>
<td>resend last packet</td>
</tr>
</tbody>
</table>
Initially, non-digipeated protocol
All transmissions are followed by an ACK packet by receiver
Speak when spoken to
Room for some command set expansion, limited by code space and RAM
Bathometry

- Utilize DGPS and a sonar device to map the bottom of a lake
- Garmin Fishfinder 100 provides depth information via a NMEA 0183 sentence
- Very rapid development, got fish finder on Friday morning: Friday afternoon software and electronics hardware is ready to run
- Building a library of functions that can be easily adapted to most applications
Questions and Suggestion for other future applications