Wireless Temperature and Pressure Sensors for STERIS Controller

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STERIS
Frank Zelina

Outline

- Problems & Objectives
- Design Concept
- Wireless Technologies
- Deliverables
- Budget
- Professional Awareness
- Timeline
Problems & Objectives

- Create wireless sensor solution
- Steam sterilization units
- Large metal chambers that involve wiring of:
  - Sensors
  - PC Board
  - User Interface
  - Safeties Interlocks
- Installation hassle and cost
- Limited scalability
- Wires touching hot surfaces

Design Concept

- Wireless Technologies
  - IEEE 802.15.4 protocol - Low data rate wireless personal area networks (WPAN)
  - ZigBee or low power star networks
  - 2.4Ghz vs Sub 1Ghz (915Mhz) frequencies
- Sensor Interface
  - Analog to digital circuit
  - Resistance Temperature Detectors (RTD) → 0-10Volts
  - Pressure Transducer (PT) → 4-20mA
- RS-485 Ethernet Communications
- Software Development
Design Concept

- LCD Display
- Control Board
- LCD Display
- Sensor
- Analog to Digital Converter
- Transmitter
- RTD: 4-20mA
- PT: 0-10V
- Wireless Channel
  - 2.4GHz or 915Mhz

Wireless Technologies

- Star Network
  - 2.4GHz @ 250Kbps
  - One coordinator and multiple end nodes
- Sub GHz technologies
  - 915Mhz low power star networks
- Transmission Power
- Reliability
- Low Interference
  - Separate Personal Area Network (PAN) ID for each network

E - End Node
C - Coordinator
Wireless Technologies

- Xbee and Arduino
  - Proof of concept
  - Transmit voltage at Xbee A/D input
    - 0-1.2 Volts
    - 3 end nodes & 1 coordinator
  - Provides understanding of RF transmission

Deliverables

- 2.4GHz or Sub GHz (915Mhz) star network system
- 10 bit or more A/D
- 24VDC plug in power supply
  - Possibility of future cordless power solutions
- ARM Cortex micro-processor options
  - Mbed enabled board
  - Platform based off Atmel SAM D21 evaluation kit
- Common board for different types of sensors
- PCB design and working device
- Software interface with main controller
Budget

<table>
<thead>
<tr>
<th>Item</th>
<th>Price Per Board</th>
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<tbody>
<tr>
<td>Xbee XB24CZ7UIS-004</td>
<td>$17.50</td>
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<tr>
<td>Atmel ATZB-RF-233-1-C-ND</td>
<td>$29.62</td>
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**Estimates of other Expenses (Excluding Manufacturing)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Price Per Board</th>
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<tbody>
<tr>
<td>ARM Cortex Processor</td>
<td>$2-4</td>
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<tr>
<td>Misc. electronic components</td>
<td>$10-20</td>
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<tr>
<td>PCB Blanks</td>
<td>$15-25</td>
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<tr>
<td>Wireless Module</td>
<td>$17.50 – 29.62</td>
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</tbody>
</table>

**Total Per Completed Board** $44.50 – 78.62 per board

**All prices estimated from www.Digikey.com**

Professional Awareness

- Responsibility to make product secure
  - Ensure privacy of STERIS information
  - Prevent solution from being abused as backdoor to access STERIS client (e.g., hospitals, research centers) networks
- Develop solution that embodies the best choice based on facts and test results, and not the one most in favor
  - Prioritize security
  - Prioritize safety
- Understand the end goal and purpose
- Realize the future potential of wireless sensor applications within STERIS
## Timeline

<table>
<thead>
<tr>
<th>Task</th>
<th>Duration</th>
<th>Who</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Team Building</strong></td>
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<tr>
<td>Interview with STERIS</td>
<td>1d</td>
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<td>Meeting Time and</td>
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<td>Sign Contract with STERIS</td>
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<td><strong>Research Strategy</strong></td>
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<td>2.4Ghz vs 915 MHz testing</td>
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<td>AG, NY, AMF</td>
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<td>Research protocols</td>
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<td>AA, AMF</td>
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<td>Hardware design</td>
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<td>AA, AG</td>
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<td>Sensor integration</td>
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<td>Software implementation</td>
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<td><strong>Prototype</strong></td>
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<td>Order parts</td>
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<td>Assemble</td>
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<td>Test</td>
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<td>Alpha prototype complete</td>
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<td>Client Reaction</td>
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<td>Final Report</td>
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The timeline includes tasks such as team building, research strategy, and prototype development, with specific durations and responsible parties. The chart also categorizes tasks into different sections: team building, research strategy, prototype, and report, each with its own tasks and timelines.