Design of a Wireless Noninvasive Core Body Temperature Sensor

Eric Baccei, Eric Macorri, Cameron Williams
Advisor: Ulkuhan Guler

ICAS Lab.
Dept. of Electrical & Computer Engineering
Worcester Polytechnic Institute
Why Core Body Temperature?

Core temperature is a key factor in early detection of health problems

- Core temperature remains rather constant when compared to extremity temperature.
- Drops in core temperature can be a symptom of sickness or vital failure, generally an issue during bypass when the patient can become hypothermic.
- Rising core temperature can proceed exhaustion or heat stroke.

Body Core and Extremity Temperature  Quast, 2015
State of the Art Sensors

Esophageal Temperature Measurement

Invasive Rectal CBT Sensor

Noninvasive Wearable CBT Sensor @ Core
Operating Principle - Dual Heat Flux

Feng, 2017
Proposed System Diagram
Breadboard Design
Printed Circuit Board (PCB) Design
Sensor Design
Code Development/App Interface

- Initialize ADC, I/O, Clock, BT Radio
- Sample Data
- Run calculation
- Store Data
- Switch MUX Sample Data
- Output over Bluetooth
Experiment Setup
Results of Test on Human Subjects

- Measured Temperature
- Expected Temperature

Core Body Temperature (C)

Time (m)
Potential Problems

- Design of cover and material could allow much greater ambient temperature affects.

- Insulation being non-uniform and containing air gaps could allow for great variance between sensors.

- Analog sensors with high voltage to temperature sensitivity results in voltage offset having large impact on readings.
Conclusion

- We have designed and developed a prototype to measure the critical vital parameter of corebody temperature noninvasively.
- Our sensor relies on Dual Heat Flux model.
- We have demonstrated a working system that is tested on humans.
- There is some discrepancies in the measurement results. We suspect this error is caused by the sensor construction, particularly gaps in the insulation.
References


Debugging Efforts

Water Test at 32 Degrees C

Water Test at 33 Degrees

Water Test at 36 Degrees C

Water Test at 40 Degrees C