BLE-TSTAT

Two-Wire BLE Thermostat Adapter

ELECOMP Capstone Design Project 2020-2021

Sponsoring Company:

Taco Comfort Solutions

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Taco Comfort Solutions is continuing support of the URI ELECOMP Capstone Design Program for the 4th consecutive year.

2017-2018: Cellular Pump Control
2018-2019: Cellular Pump Control
2019-2020: Voltage to PWM Converter (Winner of 1st Prize at Symposium 2019)

Company Overview:

Taco Comfort Solutions is a third generation, family-owned American manufacturer of high quality, high-efficiency heating, cooling, plumbing, and irrigation products. Our expertise, products, and support save our customers energy, money, and resources while improving their indoor environmental quality. We engineer and manufactures fluid control solutions for industry, agriculture and energy exploration. Our expertise, reliability and field support boosts customer productivity and return on investment.

Headquartered in Cranston, RI, Taco is global in scope with manufacturing facilities in Rhode Island, Massachusetts, Arkansas, Ontario, Vietnam and Italy. Its skilled employees produce precision pumps, valves and controls, air-dirt separators, heat exchangers, tanks, domestic hot water recirculation systems, and web-based building management controls.

Since its founding, Taco has been dedicated to the success of its people and its customers, bringing products to market that save energy, enhance system longevity, and provide a superior level of safety and comfort to building occupants.

With nearly 100 years in the HVAC industry, Taco's knowledge and engineering expertise is passed along to professionals through the company's expansive factory training and online learning programs. That same depth of experience is applied every day at hundreds of job sites across the country, making Taco one of the most trusted names in controlling the flow of water.

Technical Directors:

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We will be available for virtual meetings, campus visits, and hosting Cranston, RI factory visits for the team as needed.

Project Motivation:

In North America, hydronic heating systems typically are controlled with a thermostat located in each heating zone. All the thermostats can be wired directly to an electronic controller, which simplifies wiring in the mechanical room. Taco Comfort Solutions is currently the market leading manufacturer of hydronic electronic controls.

Many older mechanical thermostats operate with two wires, essentially acting as a switch that closes when the thermostat is calling for heat. However, in the past decade, smart thermostats have gained widespread adoption in the marketplace. Smart thermostats typically require a third wire ("C" – common) for power supply return path for most reliable operation.

If the third thermostat wire does not already exist in the existing hydronic heating system, it is necessary to pull new 3-wire thermostat cable. This can be a major challenge and/or expense for homeowners looking to upgrade their heating system to use smart thermostats.

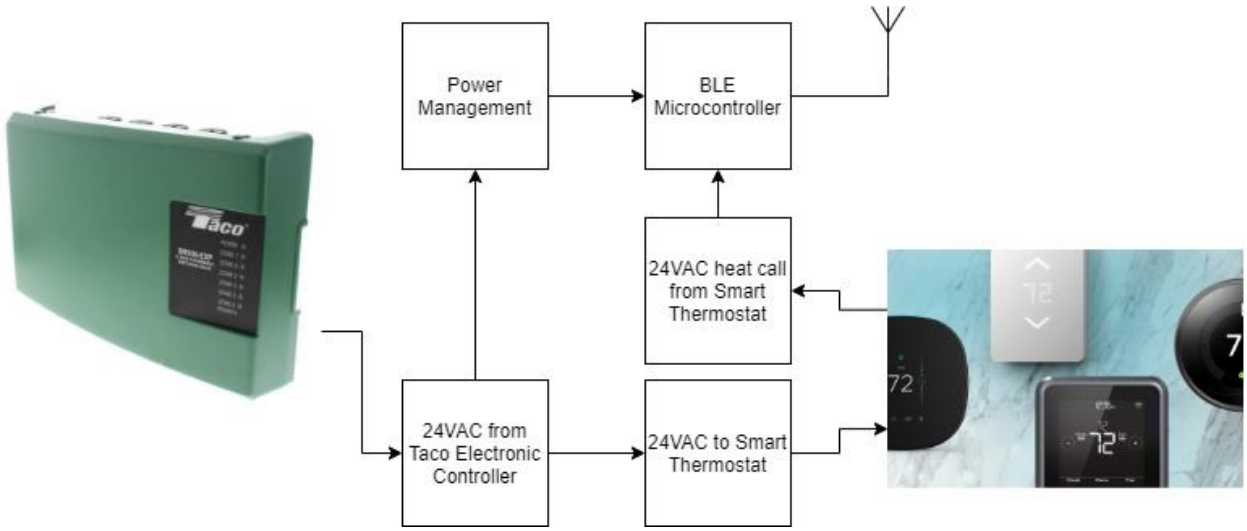
The motivation for this project is to enable retrofit installations of smart thermostats using existing two-wire thermostat cables in hydronic heating systems.

Anticipated Best Outcome:

Develop the hardware and firmware to pass power via two thermostat wires from an electronic zone controller to a smart thermostat, read the smart thermostat heating call signal, and transmit a Bluetooth Low-Energy (BLE) signal when the smart thermostat heating call state changes.

Project Details:

Develop a system that takes in 24VAC power from a Taco Electronic Controls product, passes that power to a smart thermostat, reads in the heating call signal from the smart thermostat and communicates that information via BLE.



Hardware Tasks:

- Research component selection for
  - Compatibility with existing Taco Comfort Solutions products and R&D projects
  - Cost
  - Availability
  - Vendor technical support
- Cost/power tradeoff study for power management design (namely: LDO vs buck for 24VAC to microcontroller supply)
- Schematic
- Layout
- Build & verify prototypes

Firmware Tasks:

- Develop firmware to monitor the smart thermostat heating call signal and transmit that information via BLE
- Ensure firmware compatibility with existing Taco Comfort Solutions R&D projects

Composition of the Team:

1 Electrical Engineer & 1 Computer Engineer

Skills Required:

Electrical Engineering Skills Required:

- Power management design (possibly either LDO or DC-DC buck)
- BLE microcontroller circuit development
    - RF (2.4GHz) design considerations
- 24VAC signaling input to microcontroller circuit development
- Schematic capture
- PCB layout

Computer Engineering Skills Required:

- Develop firmware to read in smart thermostat heating call signal (GPIO, timers, etc.)
- Develop firmware to communicate the smart thermostat heating call signal via BLE (vendor supplied SDK)
- Utilize existing Taco firmware libraries

Anticipated Best Outcome's Impact on Company's Business, and Economic Impact

Develop the hardware and firmware; have a functional prototype ready for alpha testing in the lab and possibly field alpha testing. Increase sales of electronic controls by enabling easier retrofit installations of smart thermostats, which consumers are demanding.

Broader Implications of the Best Outcome on the Company's Industry:

Taco Comfort Solutions will increase its market position in the hydronic electronic controls marketplace.