

Building a Better Thermostat

Matthew Treinish

mtreinish@kortar.org

[mtreinish on Freenode](#)

<https://github.com/mtreinish/building-a-better-thermostat>

March 18, 2017

Poughkeepsie, NY



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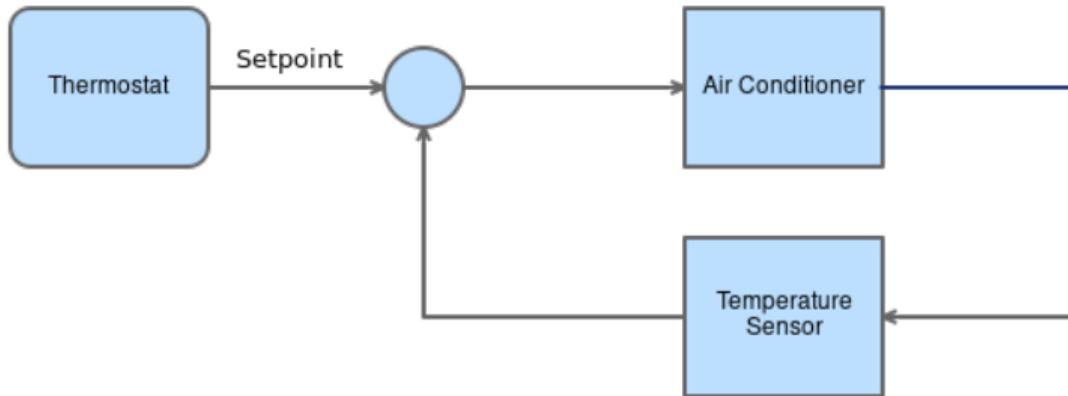
Room Layout



Air Conditioner Units



Thermostat



- ▶ Closed Loop control device
- ▶ 1 input temperature sensor
- ▶ 1 output for controlling heating and/or cooling system

Controlling the AC

- ▶ Can't take apart the Air Conditioner (I don't own it)
- ▶ No identifying information for the AC
- ▶ Control via power (use a relay to turn on and off)
- ▶ Wireless control ideal

Using Z-Wave

- ▶ Setup a Z-Wave network with Aeotec Z-Stick and OpenZWave
- ▶ Used Z-Wave outlet switch to control power to AC Units
- ▶ The same Z-Wave network can be used to add additional sensors and control devices



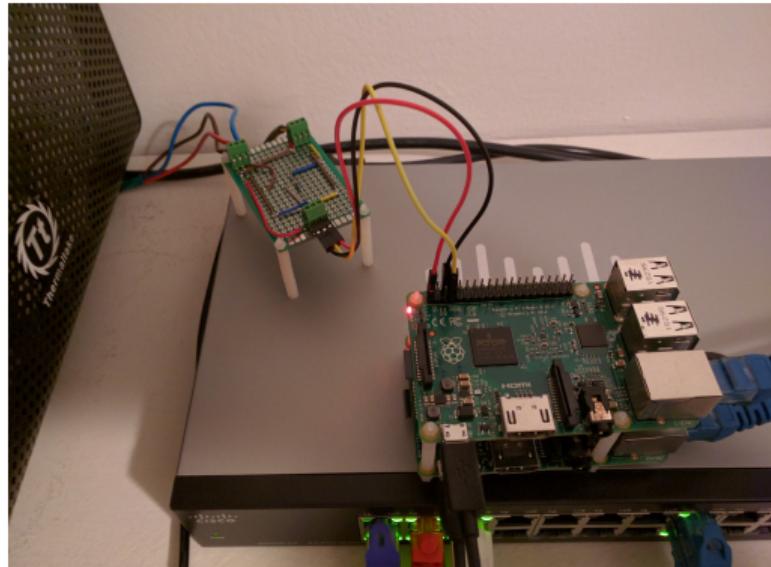
Sensing the Living Room Temperature

- ▶ Wireless sensor
- ▶ Leverage Z-Wave network
- ▶ Purchased a Z-Wave multi sensor which included temperature



Bedroom Temperature Sensing

- ▶ Track both bedroom and “data” closet temperatures
- ▶ Leverage spare raspberry pi sitting in “data” closet
- ▶ DS18B20 Dallas 1 wire temperature sensors used



Home Assistant

- ▶ Open Source Home Automation Platform
- ▶ Written in Python 3
- ▶ Has support for over 600 different components
- ▶ Runs locally (with all data locally)

Setting up thermostat in Home Assistant

<https://home-assistant.io/components/#climate>

 EQ3 Bluetooth Smart Thermostats Climate	 ecobee Thermostat Climate	 Generic Thermostat Climate	 heatmiser Thermostat Climate
HomeMatic Homematic Thermostats Climate	Honeywell Honeywell Thermostat Climate	 MySensors HVAC Climate	 Nest Thermostat Climate
 Netatmo Thermostat Climate	Oem OpenEnergyMonitor WiFi Thermostat Climate	 Proliphix Thermostat Climate	 Radio Thermostat (3M Filtrete) Thermostat Climate
 Vera Thermostat Climate	wink Wink Thermostat Climate	 Z-Wave Climate Climate	

- ▶ Many thermostat modules depending on hardware
- ▶ My use case requires the generic thermostat component to run it in software
- ▶ In Home Assistant config define generic thermostat devices with a temperature sensor and switch pair

Home Assistant Web Dashboard

The screenshot displays a Home Assistant dashboard with four main sections: Living Room, Bedroom, Data Closet, and Automation.

- Living Room:** Shows sensor values for Aeotec ZW096 Smart Switches, Aeotec ZW100 MultiSensors, and a Living Room entity. The Aeotec ZW096 values are 0.0 A, 289.87 kWh, 0.0 W, 289.87 kWh, 122.63 V, 0, and 0 lux. The Aeotec ZW100 values are 21.0 %, 0, and 21.2 °C. The Living Room entity shows an idle temperature of 25 °C and a current temperature of 21.2 °C.
- Bedroom:** Shows sensor values for Aeotec ZW096 Smart Switches and a Bedroom entity. The Aeotec ZW096 values are 0.0 A, 19.937 °C, 0.0 A, 147.44 kWh, 0.0 W, and 0.0 V. The Bedroom entity shows a current temperature of 21.2 °C.
- Data Closet:** Shows sensor values for Data Closet Temperature, UPS Battery, and UPS Input. The Data Closet Temperature is 20.75 °C. The UPS values are 100.0 %, 27.2 V, and 123.0 V. A graph shows the temperature trend from 16 minutes ago, starting at 24.5 °C and dropping to 21.2 °C.
- Automation:** Lists seven automation rules:
 - Set Bedroom AC to 25 C when arriving home
 - Set Living Room AC to 25 C when arriving home
 - Set Living Room AC to 25 C when leave starbucks on 44
 - Set Living Room AC to 26 C when leave starbucks on 44
 - Set Living Room AC to 26 C when leaving starbucks rou...
 - Set Living Room AC to 28 C when leave home
 - Set Living Room AC to 30 C when asleep

DallasMQTT

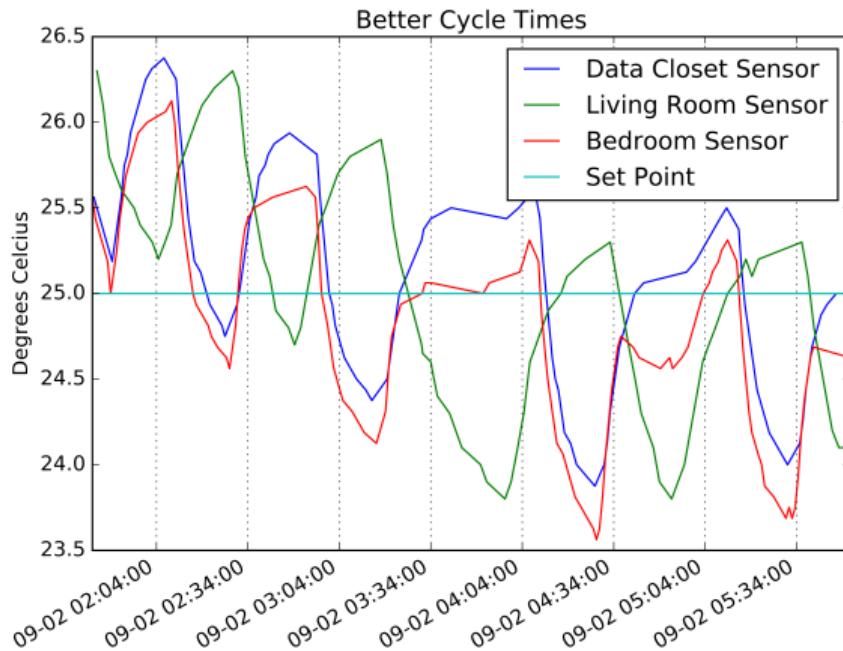
- ▶ Framework for polling sensors and pushing results on MQTT
- ▶ Handles an arbitrary number of sensors
- ▶ Currently only supports Dallas 1 wire temperature sensors from w1_therm linux driver
- ▶ Written in python

Short Cycle Time



- ▶ Bedroom on for 8 min. and off for 4 min.
- ▶ Living Room on for 4 min. off for 2 min.

Corrected Cycle Time



- ▶ Bedroom on for 20 min. and off for 21 min.
- ▶ Living Room on for 17 min. off for 29 min.

Starting to Automate

```
1 alias: Set Living Room AC to 30 C when asleep
2 trigger:
3     platform: time
4     after: '12:30:00'
5 condition:
6     - condition: time
7     before: '09:30:00'
8 action:
9     service: thermostat.set_temperature
10    entity_id: thermostat.living_room
11    data:
12        temperature: 30
```

Location Tracking

- ▶ Start writing rules based on my location
- ▶ Set temperature higher when I'm not home
- ▶ Pre-cool apartment when I'm heading home

Owntracks

- ▶ Open Source iOS and Android app for reporting location over MQTT
- ▶ Enables you to use either a private MQTT broker or public service
- ▶ Home assistant component available



Location Based Automation Rules

```
1 alias: Set Living Room AC to 26 C when leaving starbucks route 9
2 trigger:
3     platform: state
4     entity_id: device_tracker.myphone
5     from: 'Starbucks Route 9'
6 action:
7     - delay:
8         minutes: 5
9     - service: climate.set_temperature
10    entity_id: climate.living_room
11    data:
12        temperature: 26
```

Future Work

- ▶ More Sensors
- ▶ More automation
- ▶ Fix power usage collection

Where to get more information

- ▶ Blog Post <http://blog.kortar.org/?p=319>
- ▶ <https://home-assistant.io/>
- ▶ <https://github.com/mtreinish/dallasMQTT>
- ▶ <http://owntracks.org/>
- ▶ <https://github.com/openzwave/>
- ▶ W.J. Mulroy, "The Effect of Short Cycling and Fan Delay on the Efficiency of a Modified Residential Heat Pump", *ASHRAE Transactions*, Vol. 92, No. Part 1, pp. 813-816, January 1986

Questions?