

Building a Better Thermostat

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

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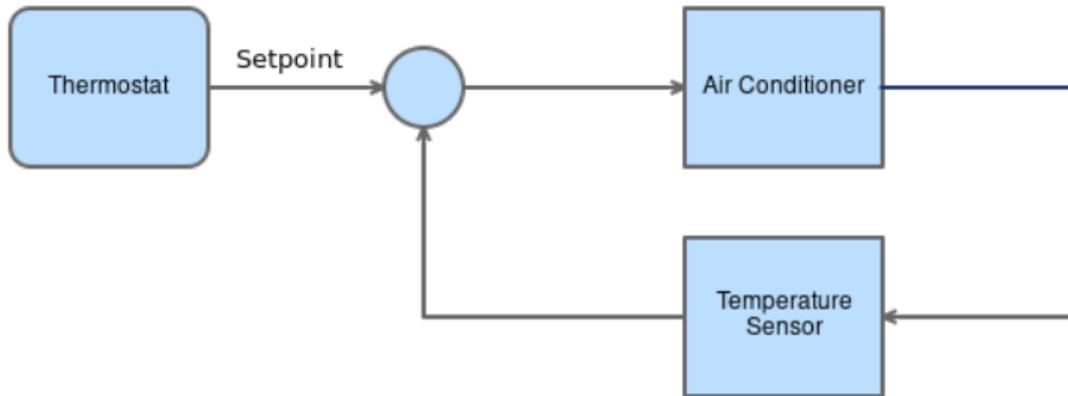
Room Layout



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



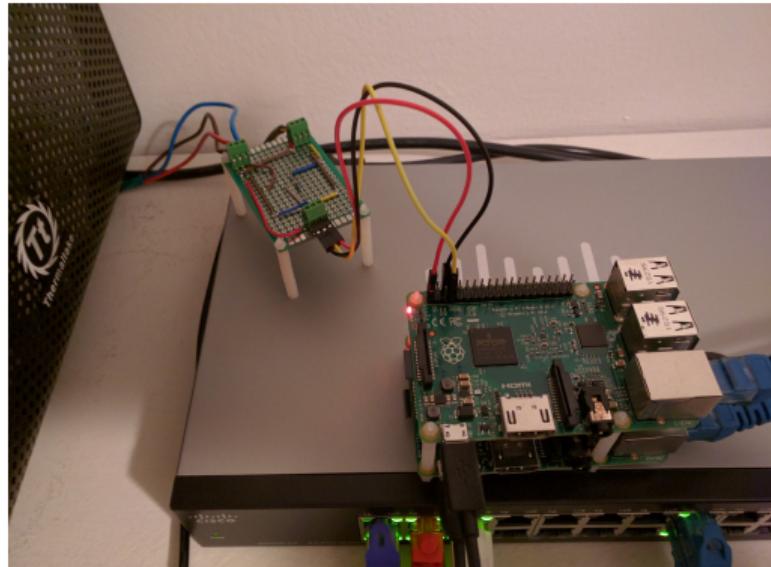
Sensing the Living Room Temperature

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



Bedroom Temperature Sensing

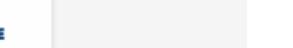
- ▶ Track both bedroom and “data” closet temperatures
- ▶ Leverage spare raspberry pi sitting in “data” closet
- ▶ DS18B20 Dallas 1 wire temperature sensors used



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

 eQ-3 Bluetooth Smart Thermostats Climate	 Ecobee Thermostat Climate	 Generic Thermostat Climate	 Heatmiser Thermostat Climate
 HomeMatic Homematic Thermostats Climate	 Honeywell Thermostat Climate	 MySensors HVAC Climate	 Nest Thermostat Climate
 Netatmo Thermostat Climate	 OpenEnergyMonitor WiFi Thermostat Climate	 Proliphix Thermostat Climate	 Radio Thermostat (3M Filtrate) Thermostat Climate
 Vera Thermostat Climate	 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 with a switch and sensor device

Home Assistant Web Dashboard

Living Room

Aeotec ZW096 Smart Switch 6 Current	0.0 A
Aeotec ZW096 Smart Switch 6 Energy	289.87 kWh
Aeotec ZW096 Smart Switch 6 Power	0.0 W
Aeotec ZW096 Smart Switch 6 Previous Reading	289.87 kWh
Aeotec ZW096 Smart Switch 6 Voltage	122.63 V
Aeotec ZW100 MultiSensor 6 Burglar	0
Aeotec ZW096 Smart Switch 6 Switch	<input checked="" type="button"/>
Aeotec ZW100 MultiSensor 6 Luminance	0.0 lux
Aeotec ZW100 MultiSensor 6 Relative Humidity	21.0 %
Aeotec ZW100 MultiSensor 6 SourceNodeId	0
Aeotec ZW100 MultiSensor 6 Temperature	21.2 °C
Aeotec ZW100 MultiSensor 6 Ultraviolet	0.0
Living Room	Idle 25 °C Currently: 21.2 °C

Bedroom

Bedroom Temperature Sensor	19.937 °C
Aeotec ZW096 Smart Switch 6 Current	0.0 A
Aeotec ZW096 Smart Switch 6 Energy	147.44 kWh
Aeotec ZW096 Smart Switch 6 Power	0.0 W
Aeotec ZW096 Smart Switch 6 Previous Reading	147.44 kWh
Aeotec ZW096 Smart Switch 6 Voltage	122.63 V
Aeotec ZW096 Smart Switch 6 Switch	<input type="button"/>
Bedroom	Currently: 21.2 °C

Data Closet

Data Closet Temperature Sensor	20.75 °C
UPS Battery	100.0 %
UPS Battery Voltage	27.2 V
UPS Input Voltage	123.0 V

Automation

Set Bedroom AC to 25 C when arriving home	<input checked="" type="button"/>
Set Living Room AC to 25 C when arriving home	<input checked="" type="button"/>
Set Living Room AC to 26 C when leave starbucks on 44	<input checked="" type="button"/>
Set Living Room AC to 26 C when leave starbucks on 44	<input checked="" type="button"/>
Set Living Room AC to 26 C when leaving starbucks rou...	<input checked="" type="button"/>
Set Living Room AC to 28 C when leave home	<input checked="" type="button"/>
Set Living Room AC to 28 C when leave home	<input checked="" type="button"/>
Set Living Room AC to 30 C when asleep	<input checked="" type="button"/>

Living Room

16 minutes ago

Idle 25 °C

Currently: 21.2 °C

22.3 min

16.0 %

20.75 °C

27.2 V

123.0 V

25 °C

21.2 °C

20.00 22.00 24.00 26.00 28.00 30.00

6:00 8:00 12:00 16:00 20:00 0:00

Target Temperature

25 °C

21.2 °C

20.00 22.00 24.00 26.00 28.00 30.00

6:00 8:00 12:00 16:00 20:00 0:00

Sun moon rain clouds 100% 0% 0% 0% 0% 0%

Aeotec ZW100 MultiSensor 6 Alarm Level

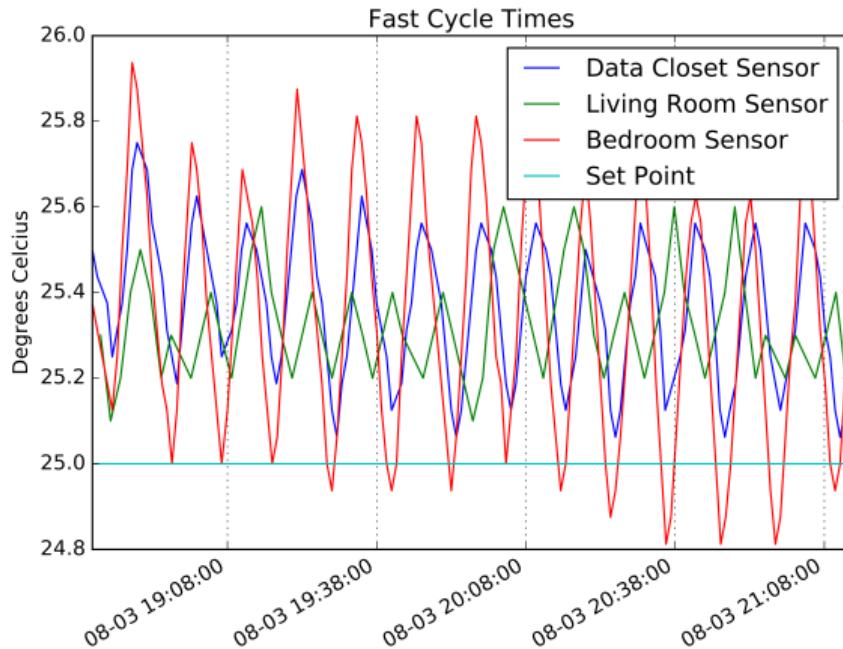
Aeotec ZW100 MultiSensor 6 Battery Type

Aeotec ZW100 MultiSensor 6 Sensor Level

DallasMQTT

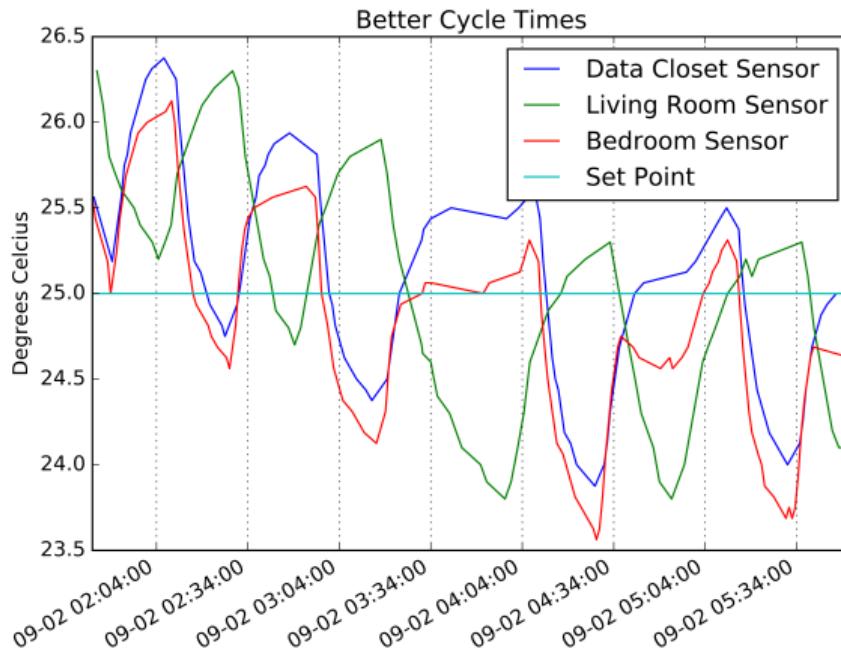
- ▶ Framework for polling sensors and pushing results on MQTT
- ▶ Handles an arbitrary number of sensors
- ▶ Currently only supports Dallas 1 wire temperature sensors from w1_therm linux driver
- ▶ Written in python

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?