

# Building a Better Thermostat

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

June 19, 2017

# Poughkeepsie, NY



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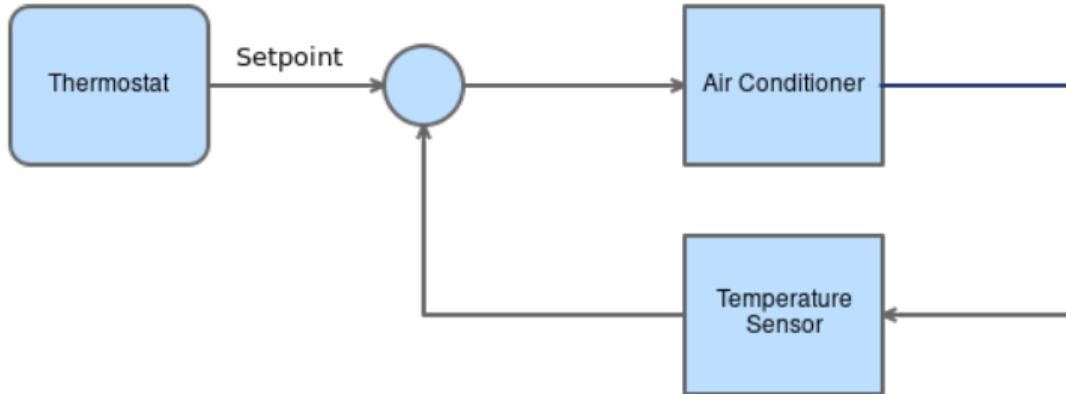
# Room Layout



# Air Conditioner Units



# Thermostat



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

## Constraints for controlling the AC

- ▶ Can't take apart the Air Conditioner  
(I don't own it)
- ▶ No identifying information for the AC
- ▶ Wireless control ideal



## Solution for controlling the AC

- ▶ Control via power (use a relay to turn on and off)
- ▶ Used Z-Wave power switch



## What is Z-Wave

## Sensing the Temperature

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



# 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



## Home Assistant

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

## First Attempt at a thermostat

this doesn't work

# Setting up a proper thermostat in Home Assistant

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

 EQ3 Bluetooth Smart Thermostats Climate	 ecobee Thermostat Climate	 Generic Thermostat Climate	 heatmiser Thermostat Climate
<b>HomeMatic</b> Homematic Thermostats Climate	<b>Honeywell</b> Honeywell Thermostat Climate	 MySensors HVAC Climate	 Nest Thermostat Climate
 Netatmo Thermostat Climate	<b>Oem</b> OpenEnergyMonitor WiFi Thermostat Climate	 Proliphix Thermostat Climate	 Radio Thermostat (3M Filtrete) Thermostat Climate
 Vera Thermostat Climate	<b>wink</b> 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 Aeotec ZW100 MultiSensor 6 Ultraviolet.
- Bedroom:** Shows sensor values for Aeotec ZW096 Smart Sensors and Aeotec ZW096 Smart Switches.
- Data Closet:** Shows sensor values for Data Closet Temperature Sensor, UPS Battery, UPS Battery Voltage, and UPS Input Voltage.
- Automation:** Lists several automation rules for setting AC temperatures based on sensor values and specific triggers like arriving home or leaving Starbucks.

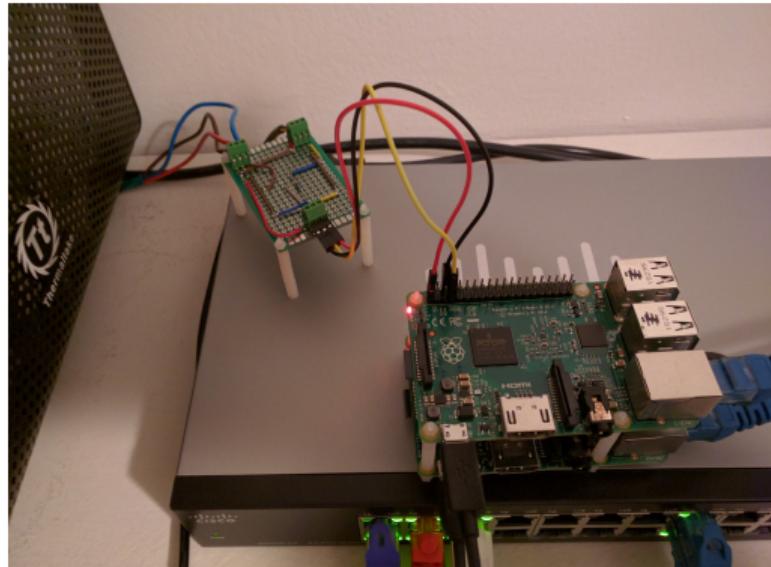
A central modal window provides detailed information about the Aeotec ZW096 Smart Switch 6 Current in the Bedroom, including its previous reading (289.87 kWh), current value (0.0 A), and a graph showing its trend over the last 16 minutes from 21.2°C down to 20.2°C.

## Problems with this...



# 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



## DallasMQTT

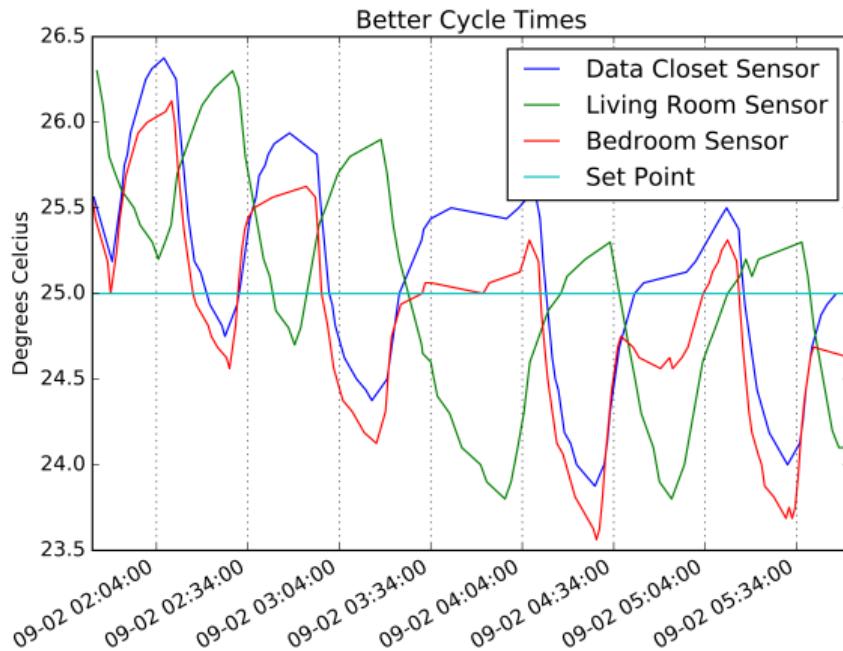
- ▶ Framework for polling sensors and pushing results on MQTT
- ▶ Handles an arbitrary number of sensors
- ▶ Currently only supports Dallas 1 wire temperature sensors from w1\_therm linux driver
- ▶ Written in python

## 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