



# **Smart Thermostat**

**Internet Of Things**

**Project Report**

Version 1.0

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# 1 Introduction

Here it is proposed an implementation of the Smart Thermostat project using **Contiki 2.7**, **NodeRED** and **ThingSpeak**.

The goal was to create a system, representing a Smart Home scenario, composed of four thermostat nodes that can be controlled and monitored using a **NodeRED** dashboard.

All the code developed for the project can be found at <https://github.com/poz1/SmartThermostat>.

In the repository there are also **dashboard.json** that contains the **NodeRED** flow and the **loglistener.txt** file with the output of all the thermostat nodes.

## 1.1 Motes

Two types of nodes are used:

- Standard border router
- Custom developed thermostat node that offers all the functionalities requested by the project

### 1.1.1 Thermostat Node

The logic of this node is in the **thermostat.c**, **thermostat.h** and **project-conf.h** files. This node communicates using the **COaP** protocol and exposes the following endpoints:

- **status** - Returns a JSON with the current status of the node
- **temperature** - Returns a JSON with the current temperature of the node every 5 seconds.
- **set** - Allows to enable or disable one of the following devices:
  - Air Conditioning
  - Heater
  - Ventilation

The motes simulate the temperature changes due to the settings using the parameters provided in the **thermostat.h** file.

In addition to that, the LEDs provided by the **SKY mote** are used to represent the current state of the mote with the following convention:

- Air Conditioning - **Blue**
- Heater - **Red**
- Ventilation - **Green**

## 1.2 Simulation

A simulation using **Cooja** was performed in order to show the interaction between the motes, the dashboard and ThingSpeak.

The complete video of the simulation can be found at <http://tiny.cc/poz1-iot>.

The following actions were performed:

1. Connection to the 4 thermostat motes
2. Enabling the heater on all motes using the general setting
3. Disabling the heater on all motes using the general setting
4. Enabling air conditioning and ventilation on motes 1,3 and 4
5. Changing the minimum temperature threshold for email notification to 10 degrees
6. Enabling air conditioning and ventilation on mote 2
7. Waiting for email notification
8. Disabling air conditioning and ventilation on all motes using the general setting

In the following pages are reported the **log of mote 1** (the complete log of all motes can be found in the repository with the code), some screenshots of the **dashboard** and the final graphs of **ThinkSpeak**.

## 1.2.1 Dashboard

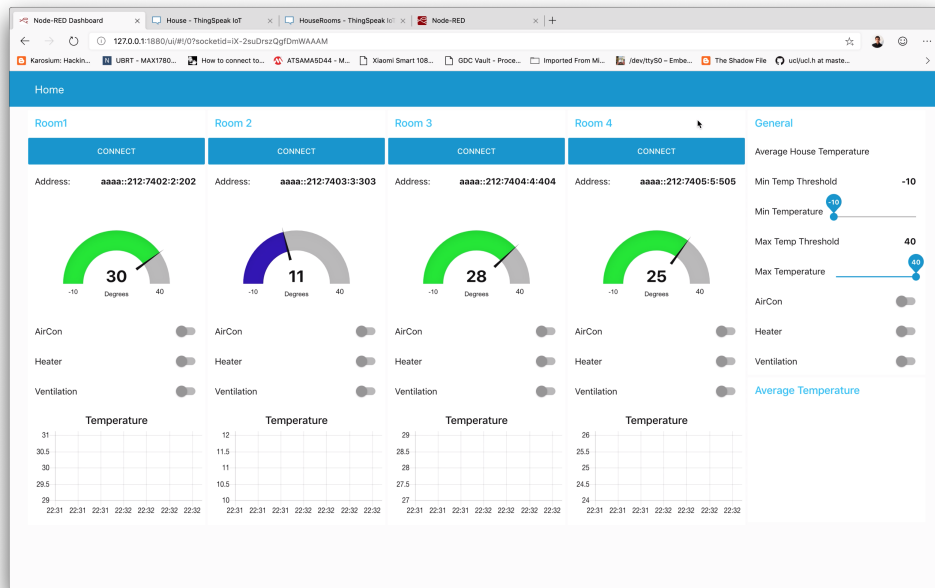


Figure 1.1: NodeRED Dashboard after connection with the motes

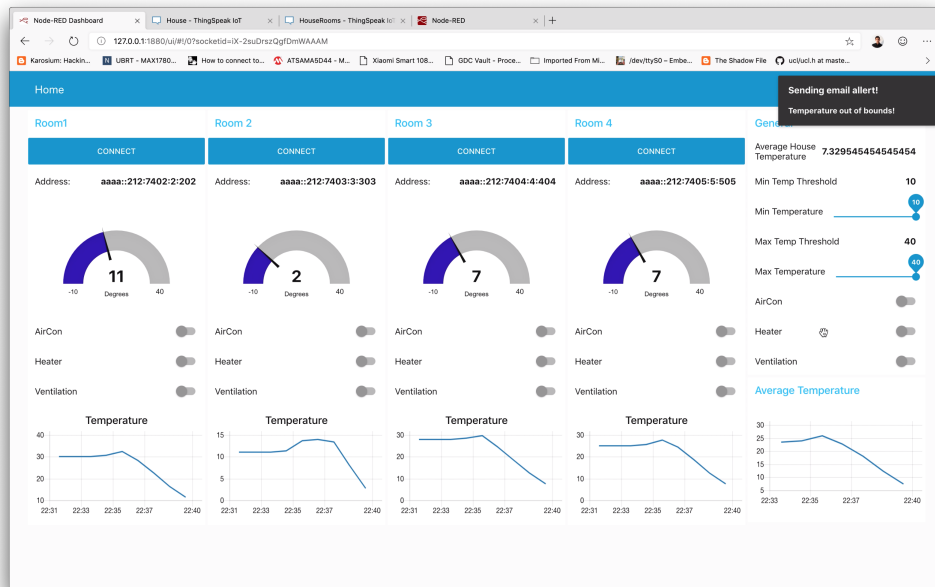


Figure 1.2: NodeRED Dashboard with Email Alert

## 1.2.2 ThingSpeak

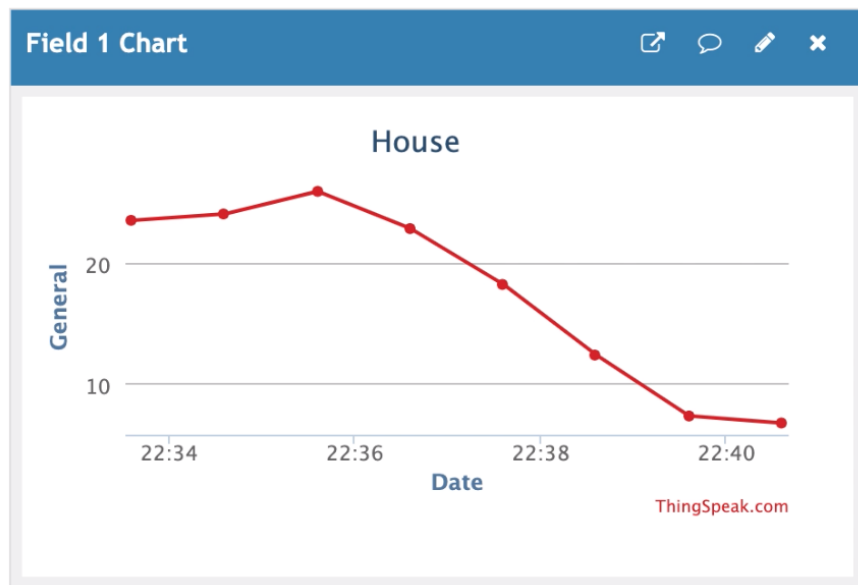


Figure 1.3: House Average Temperature Per Minute

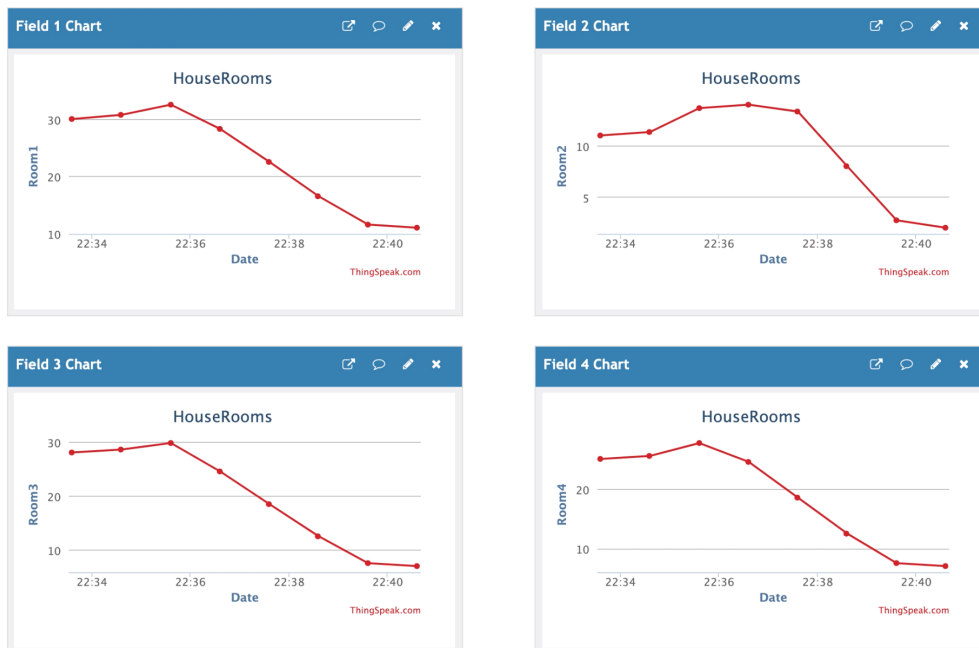


Figure 1.4: Rooms Average Temperature Per Minute

### 1.2.3 Mote Log

```
00:00.502 ID:2 Rime started with address 0.18.116.2.0.2.2.2
00:00.510 ID:2 MAC 00:12:74:02:00:02:02:02 Contiki 2.7 started. Node id is set to 2.
00:00.517 ID:2 CSMA nullrdc, channel check rate 128 Hz, radio channel 26
00:00.527 ID:2 Tentative link-local IPv6 address fe80:0000:0000:0000:0212:7402:0002:0202
00:00.529 ID:2 Starting 'Smart Thermostat'
00:00.533 ID:2 Setting initial random temperature to: 30 degrees.
08:23.463 ID:2 Changing ventilation to mode: off
08:25.439 ID:2 Changing ac to mode: off
08:26.417 ID:2 Changing heater to mode: off
09:35.733 ID:2 Changing heater to mode: on
09:40.528 ID:2 Updating Temperature to: 31
10:00.528 ID:2 Updating Temperature to: 32
10:20.528 ID:2 Updating Temperature to: 33
10:31.512 ID:2 Changing heater to mode: off
10:42.330 ID:2 Changing ventilation to mode: on
10:43.932 ID:2 Changing ac to mode: on
11:00.528 ID:2 Updating Temperature to: 31
11:20.528 ID:2 Updating Temperature to: 29
11:40.528 ID:2 Updating Temperature to: 27
12:00.528 ID:2 Updating Temperature to: 25
12:20.528 ID:2 Updating Temperature to: 23
12:40.528 ID:2 Updating Temperature to: 21
13:00.528 ID:2 Updating Temperature to: 19
13:20.528 ID:2 Updating Temperature to: 17
13:40.528 ID:2 Updating Temperature to: 15
14:00.528 ID:2 Updating Temperature to: 13
14:20.528 ID:2 Updating Temperature to: 11
14:28.360 ID:2 Changing ac to mode: on
14:33.798 ID:2 Changing ac to mode: off
14:35.535 ID:2 Changing ventilation to mode: off
14:36.400 ID:2 Changing ventilation to mode: on
14:48.408 ID:2 Changing ac to mode: off
14:49.771 ID:2 Changing ventilation to mode: off
```

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Figure 1.5: Mote 1 Log