

# Software Engineering of Internet of Things

## Sampling Handin: Temperature Sensor Calibration

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### 1 Context

- Given enough insulation the temperature of a large enough heated mass will follow a predictable path towards the temperature of the surroundings.
- The response curve (temperature  $\mapsto$  value) of a thermistor is quite simple.

### 2 Exercise

Design an experiment to calibrate the thermistor attached to your board, and create an ontology for mapping a device to a calibration.

### 3 Recipe

1. Locate your documentation.
2. ESP32 users attach the cabled temperature sensor to their IoT device.
3. Write code (i.e., a "driver") for interfacing with your cabled temperature sensor.
4. Program the IoT device to repeatedly sample the cabled temperature sensor and output the raw value over the serial (USB cable).
5. Set up your laptop to power the device and log all values coming in over the USB cable to a file in such a way that every value is timestamped.
6. Pour some warm water (e.g. 800mL at 80°C) into a container.
7. Wrap the temperature sensor in a water-tight bag and lower it into the container.

8. Log timestamped temperature raw values until the temperature has reached ambient temperature. The resulting samples represents your experimental data.
9. Every 5-20 min throughout the experiment, sample the water temperature using a trusted thermometer and write it down with a timestamp. This represents your ground truth.
10. Look up a reasonable formula for response curve of the thermistor and fit it to your ground truth. This represents your extended ground truth.
11. Note that a measured value maps to a distribution of true values. Define a function that maps a measured value to select summary statistics of this distribution (e.g., min, max, mean).
12. Create an ontology for storing this mapping.
13. Create an information model (read: RDF model) that makes use of this ontology to describe your experimental setup.
  - **Note:** The only thing we really care about here is to associate the hardware with the map.
14. Make a demo of how to use this information model.

## 4 Requirements

1. Describe the experimental setup. Use technical terms such as
  - Service
  - Workload
  - Parameter
  - Factor
  - Levels
  - Metric
2. Answer the following questions:
  - (a) Which set of parameterized functions is suitable for converting the raw value to a temperature?
  - (b) What are the parameters for your setup?
  - (c) If a single reading converted using that calibration reports a temperature of  $T$ , what can you state about the actual temperature?
3. Hand in as a group by sending a mini-report as PDF to asjo@mmmi.sdu.dk with subject  
 "SDU IoT 2020: Handin 2 - Temperature Sensor Calibration"
4. Deadline: March 18, 2020