CPSL
Cyber-Physical Systems Laboratory

Crete House Sensor Network Semester Report

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Overview of This Semester

- Temperature Sensor Network Setup
  - House Scale WSN
    - Multi-hop(CTP)
  - Surface Temperature
    - Thermal Connection(Sticker)
- Accurate Temperature Sensing
  - System calibration
- Data Process & Display
  - Computation of temperature data
  - Results display(UI)

Calibration

- Methodology
  - System Calibration
    - Every sensor node use one calibrated equation, which minimum the overall temperature error
- The ground truth temperature
  - RTD sensor
    - Measured by resistance
- Final Result
  - We calibrated the sensor under four more different temperatures. Ranging from 14.35 Celsius Degree to 39.89 Celsius Degree
  - With system calibration,
    - k = 0.0100362234052 ,b = -39.5535074677
    - With error = 0.105240537985

Why CTP?

- Unreliable network using radio
- Single-Hop limit the range of Sensor Network
- Solution: CTP Protocol
  - Retransmission between two nodes
  - Dynamically update routing information
  - Multi-Hop expand Range

TinyOS CTP

- Implementation of CTP Protocol in Telosb
  - Basestation(Root)
    - CTP Settings, Serial Setting, Dissemination Setting
    - Receive CTP packets then forward to PC
    - Forward Dissemination Value to the whole Network
  - Mote(Sensor)
    - CTP Settings, Dissemination Setting
    - Sensing Data then send packets to Root
    - Receive Dissemination Value then change period
  - PC
    - Receive Temp. Data then Send to AWS IoT
    - Send Period information to Root

Back-End

- Architecture
  - Raspberry Pi
    - MQTT
    - Json
  - AWS IoT
    - Shadow
    - Insert Rule
  - DynamoDB
  - Software
    - DynamoDB SDK
    - PyQt

Raspberry Pi

AWS IoT

DynamoDB

Software

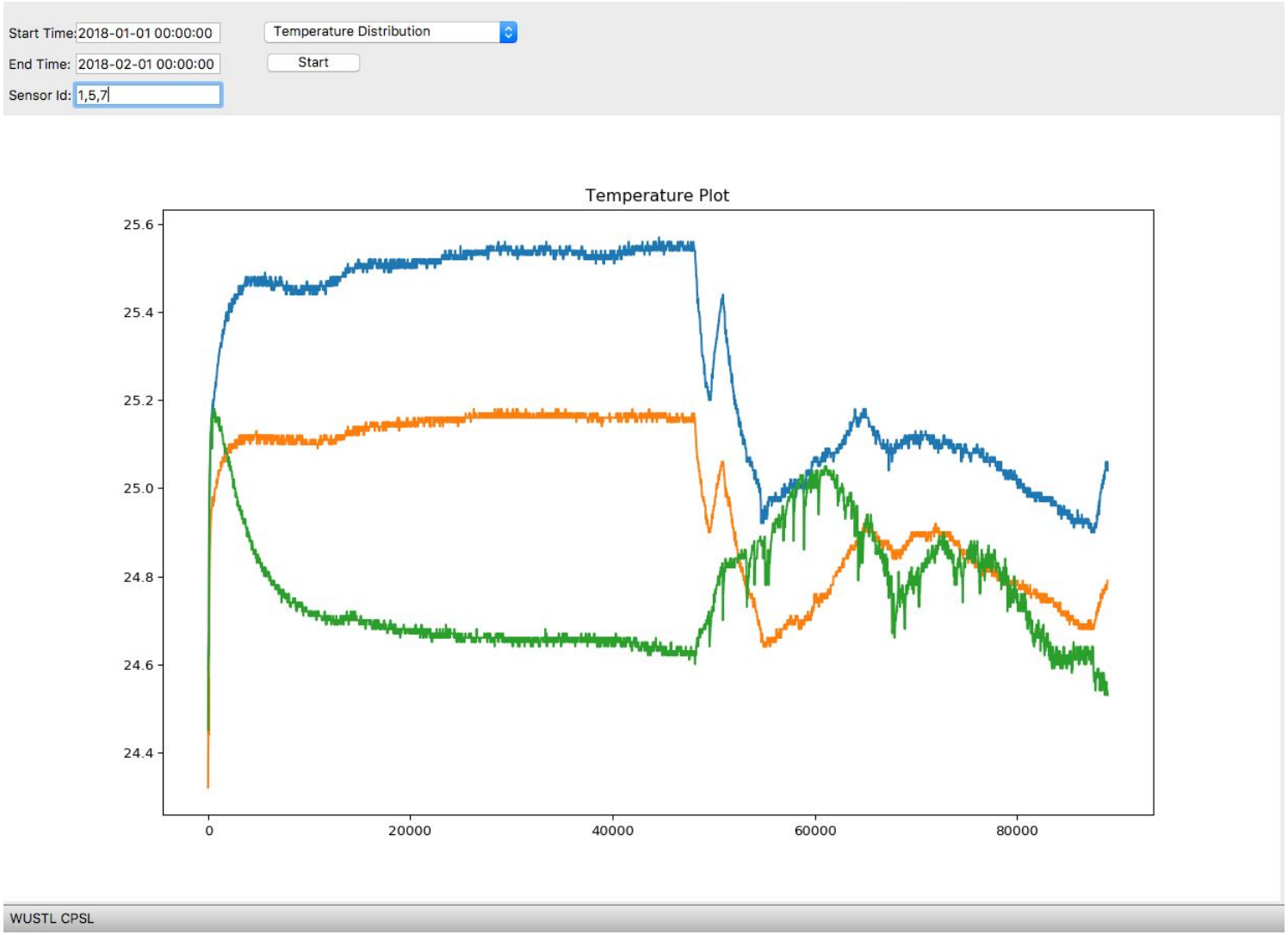
Back-end Setup

- MQTT Publisher on Raspberry Pi
  - With Parameters related to thing
    - Path to certificate files
- AWS IoT and DynamoDB Setup
  - Easily Setup on AWS console
    - Thing, Rule, Database
- Software to Manage Data
  - Provide UI to have a look at temperature data.

User Interface

- Using PyQt5
- Input:
  - Start time, End time. Both in the form of YYYY-MM-DD hh:mm:ss
  - Sensor Id
- Three Features:
  - Compute the average temperature for a particular sensor over the specified time period
  - Get the latest temperature reading for a particular sensor over the specified time period
  - Plot temperature for multiple sensors over the specified time period

UI Example


Start Time: 2018-01-01 00:00:00
End Time: 2018-02-01 00:00:00
Sensor Id: 1,5,7
Temperature Distribution
Start
Temperature Plot
25.6
25.4
25.2
25.0
24.8
24.6
24.4
0
20000
40000
60000
80000
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WSN Usage

- Hardware
  - one Raspberry Pi3 connect one node
  - many telosb nodes
  - one laptop
- Software
  - Basestation program load on the node connect with Pi3
  - Mote program load on other nodes
  - UI program load on PC
- AWS Backend
  - According to the installation guide
- House needs to have WIFI access

Summary

- Completion so far
  - Implementation of CTP
    - Experiments of validating its reliability needs to be done
  - Back-end
    - Documentation needs to be done
  - Calibration
    - Finished