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SAARC ENERGY CENTRE
Energy for Peace & Prosperity

Digitalization and Electricity Monitoring

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Top10 China
9 December 2021

Profile

- Researcher
  - Motor system energy efficiency
  - Appliance energy efficiency standards and labels
  - Cooling efficiency
  - Industrial IoT standardization
- **Programmer**
  - Embedded device and system
  - IoT cloud OPC UA server
  - Web application
  - Web crawling
- Coordinator
  - International cooperation
  - Technology transfer

Table of content

- Why is digitalization needed?
- What is digitalization?
- How to do digitalization?
- Cases
  - Environment monitoring
  - Electricity monitoring
  - Smart pump system
  - Smart watering
  - ……

Why digitalization? - benefits

1. Reduces costs
2. Decentralizes production
3. **Enhances efficiency and productivity**
4. Creates new business opportunities
5. Accelerates reaction to demand trends
6. Fosters competitive advantage
7. Stimulates innovation against disruption
8. Boosts internal cohesion
9. Improves use of data capacity
10. Bring new talent’s interest

Why digitalization? - benefits

Why digitalization? – benefits for motor systems

1. Improve efficiency
2. Energy performance audit
3. Predictive maintenance
4. System re-design & re-size

What is digitalization? – terms and definitions

- **Digitalization** is the process in which aspects of social life are restructured around digital communication.
- **Digitization** is the process of converting information into a digital (i.e. computer-readable) format. The result is the representation of an **object**, image, sound, document or **signal** (**usually an analog signal**) by generating a series of numbers that describe a discrete set of points or samples.
- **Digital Transformation**: refers to a company adopting a digital technology.

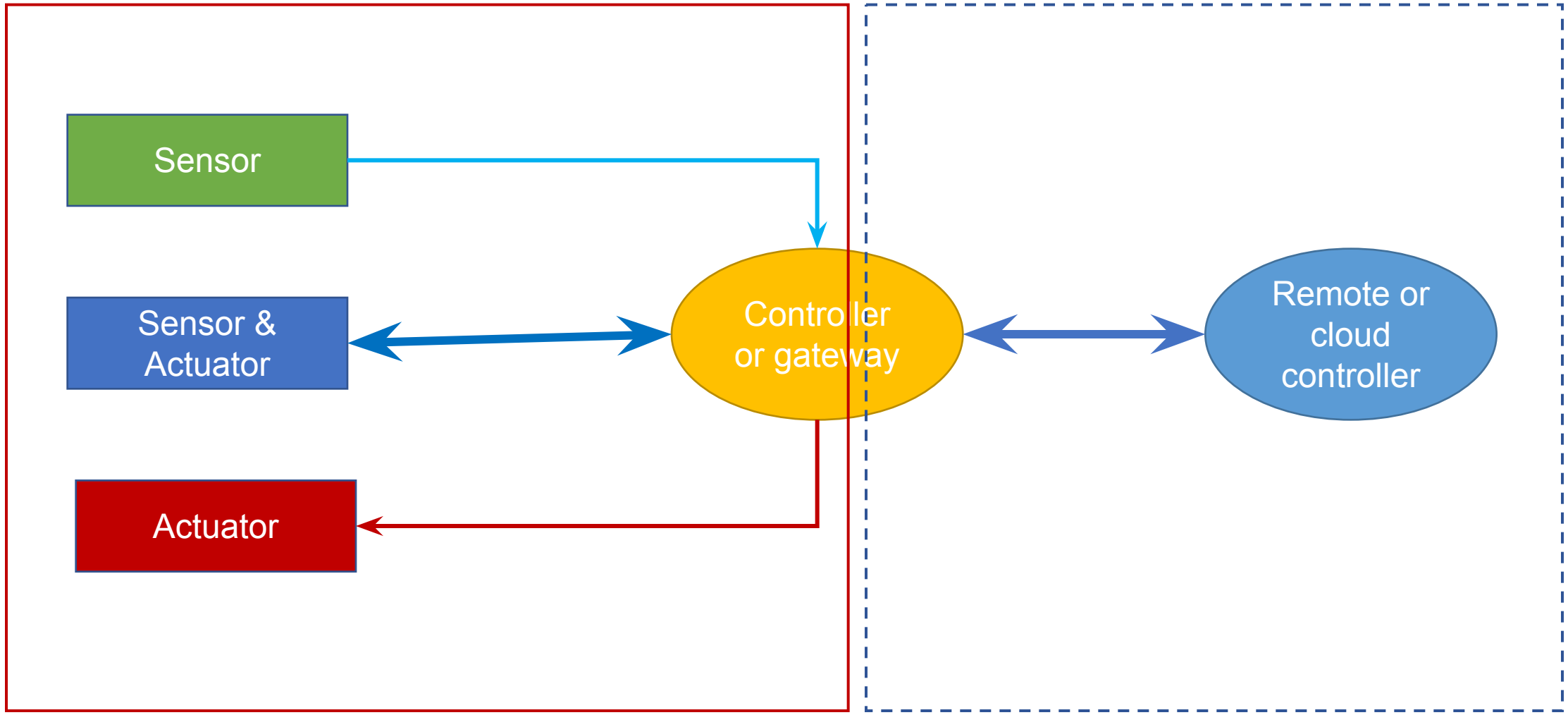
What do we want to sense?

- Environment
  - Air quality: PM2.5, PM10, air pressure, NOx, SOx, O_3, CO2
  - Water quality: BOD, COD, turbidity
  - Temperature & humidity
  - Hazardous gas: TVOC, CH2O, etc
  - Soil: wetness, turbidity
- Energy
  - Electricity: power, voltage, current, power factor
  - Liquid: quantity, velocity, pressure
  - Air flow: quantity, velocity, pressure
- Others
  - Rotating speed
  - Vibration
  - Lighting brightness
  - Thermal

What do we want to control?

- Operation on and off
  - Motor
  - Power system
- Speed
  - Voltage and current
  - Frequency
- Status
  - Valve opening rate
  - Damper opening rate
  - System operation configuration

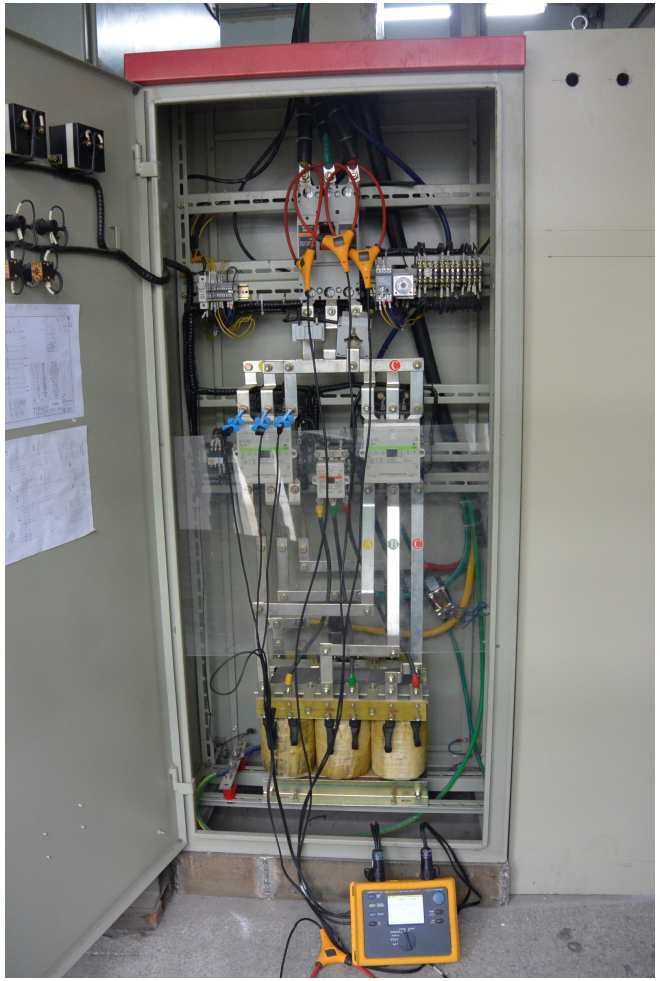
How do we sense and control?

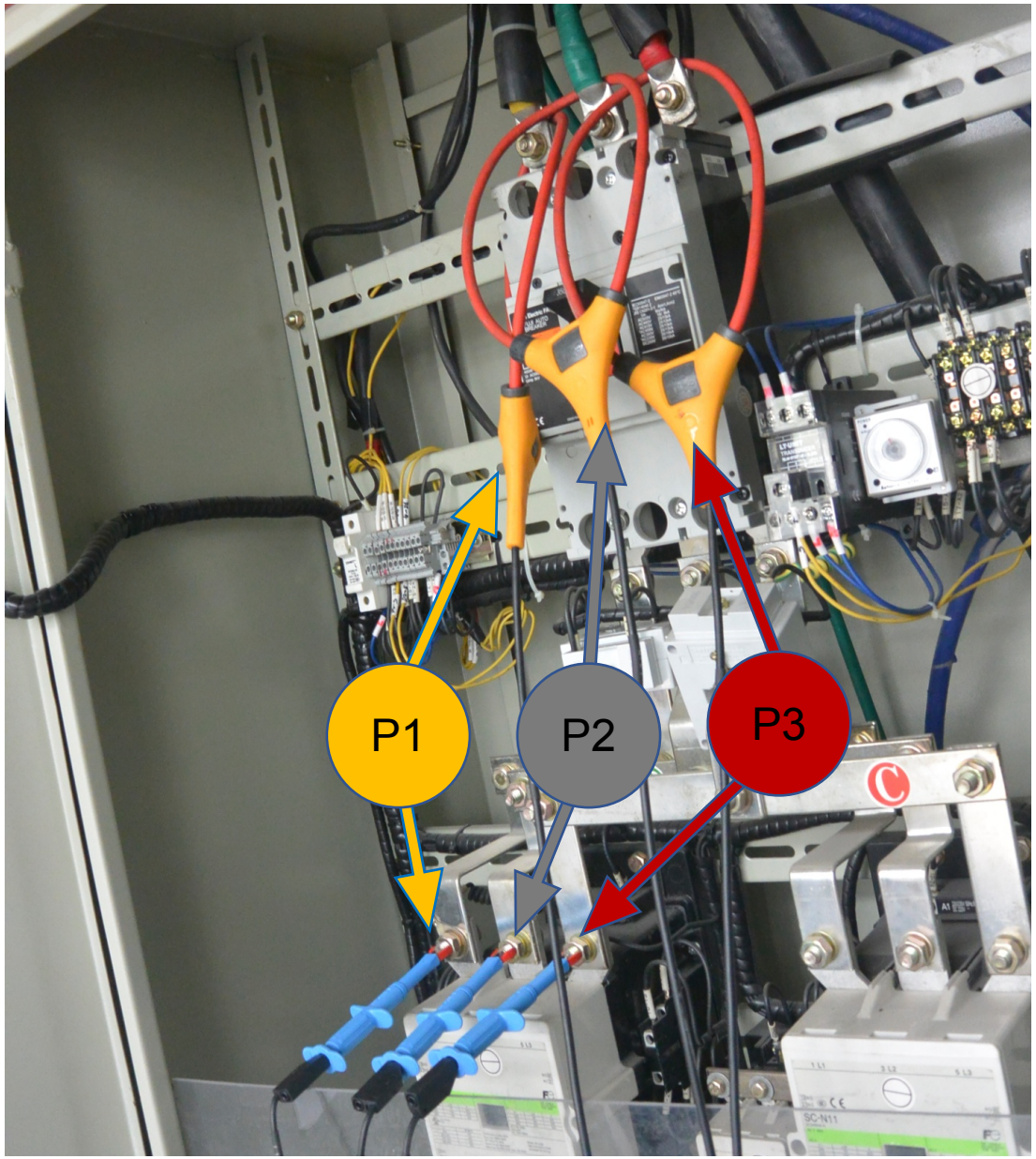


Level 1 sense : traditional meters

Level 2 sense : digital meters

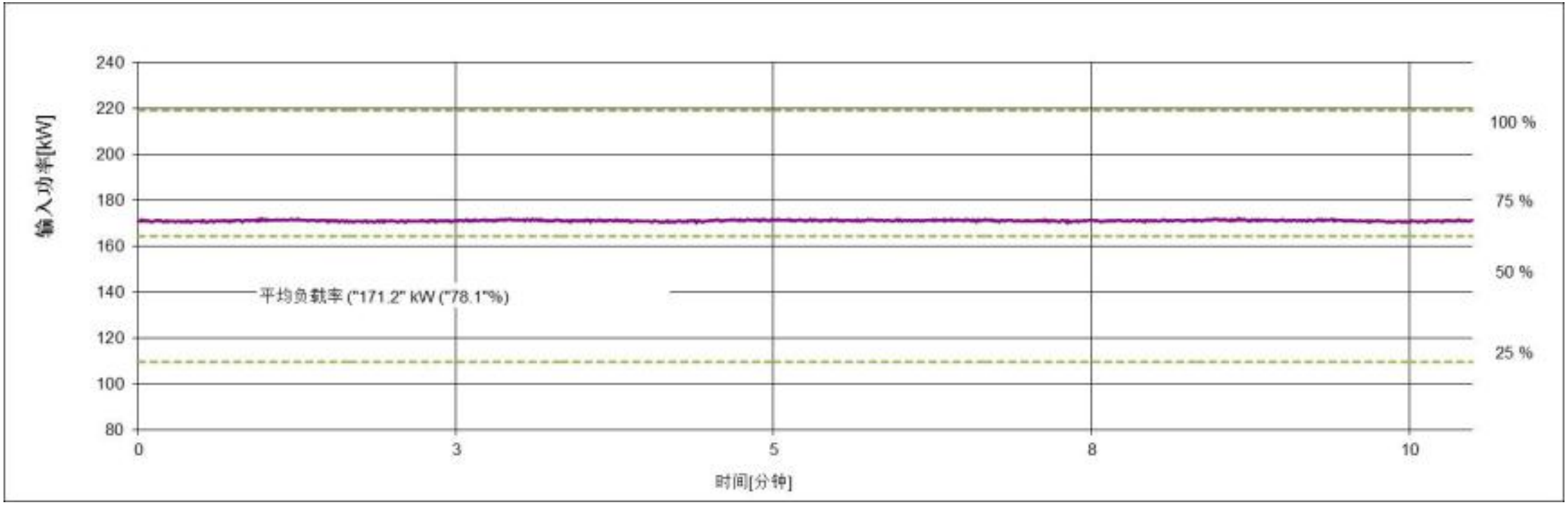
Level 3 sense: external digital meter



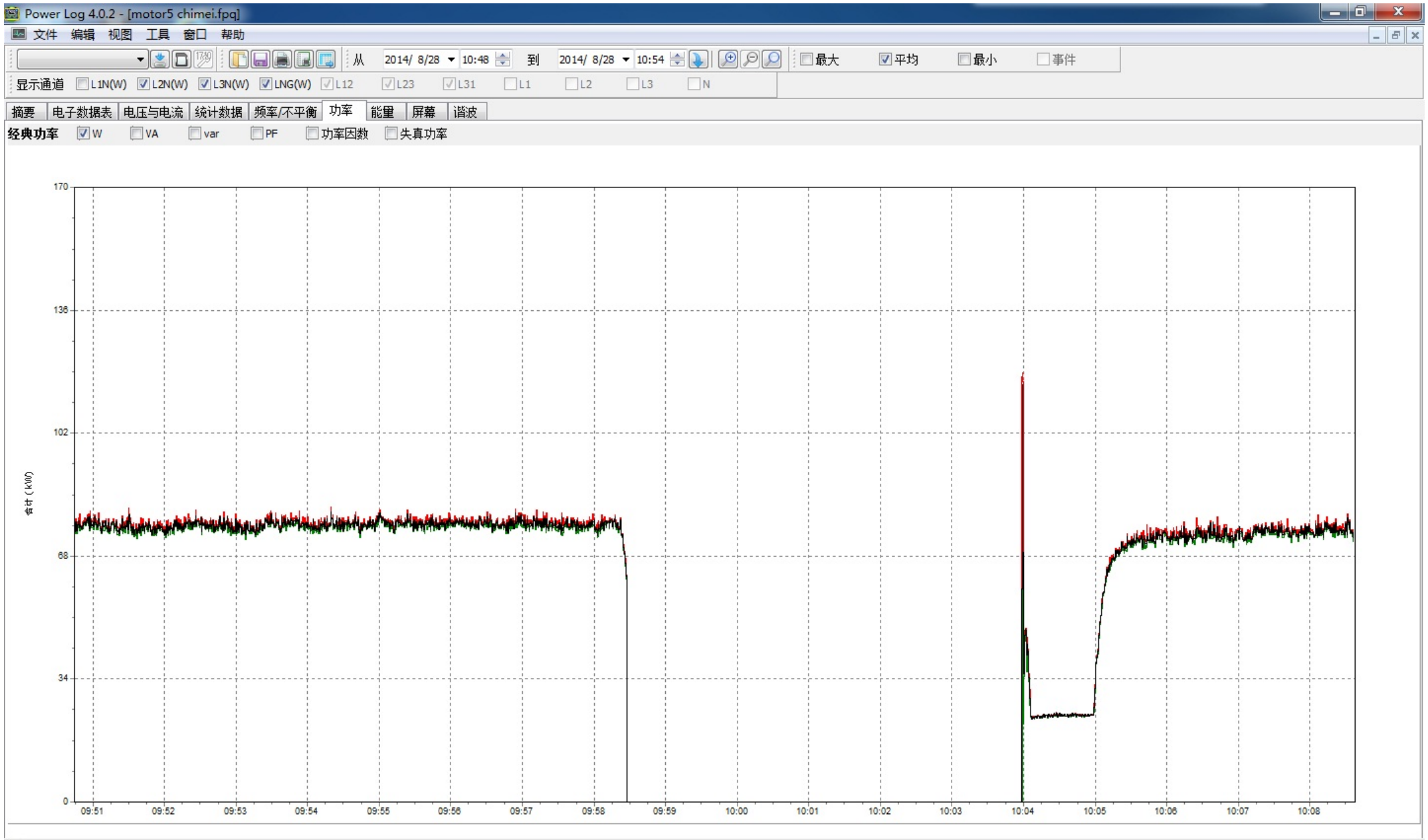

P1
P2
P3

CURRENT INPUT
FLUKE 1735 POWER LOGGER ANALYST
VOLTAGE INPUT
HOLD RUN
RECORD MEASURE
CURSOR
ENTER SAVE SCREEN
ESC MENU
2014-08-27, 14:10
L123 Ptot 86.5kW PFtot 0.766
Ptot max 88.4kW min 85.6kW
PFtot max 0.782 min 0.763
2 min
3 min
4 min
POWER
EVENTS
HARMONICS
SCOPE
METER

Case: pump system operation



Case: air compressor system operation



Level 4 sense: sample, show and transmission

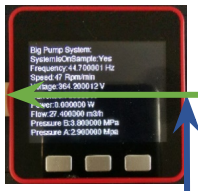
Smart sensors and meters

Graphical, dynamical clients

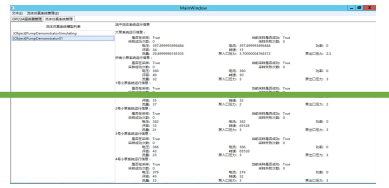
VFD

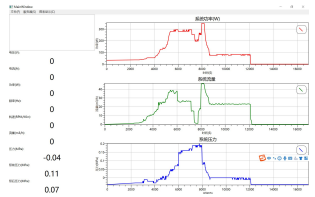
Data gateway

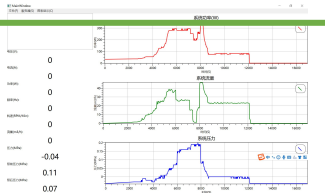
Modbus



Cloud Server







Flow

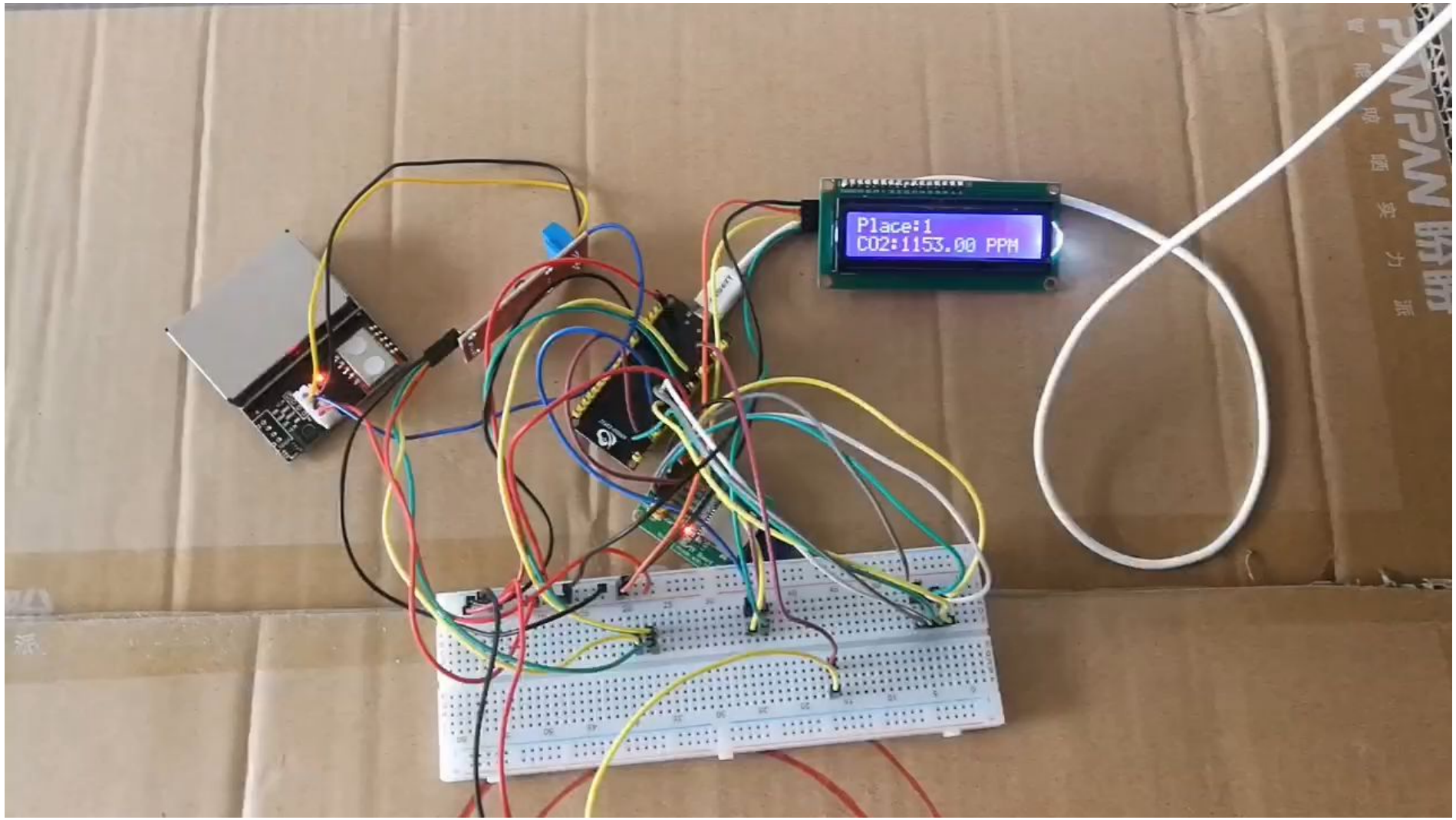
Pressure

Power

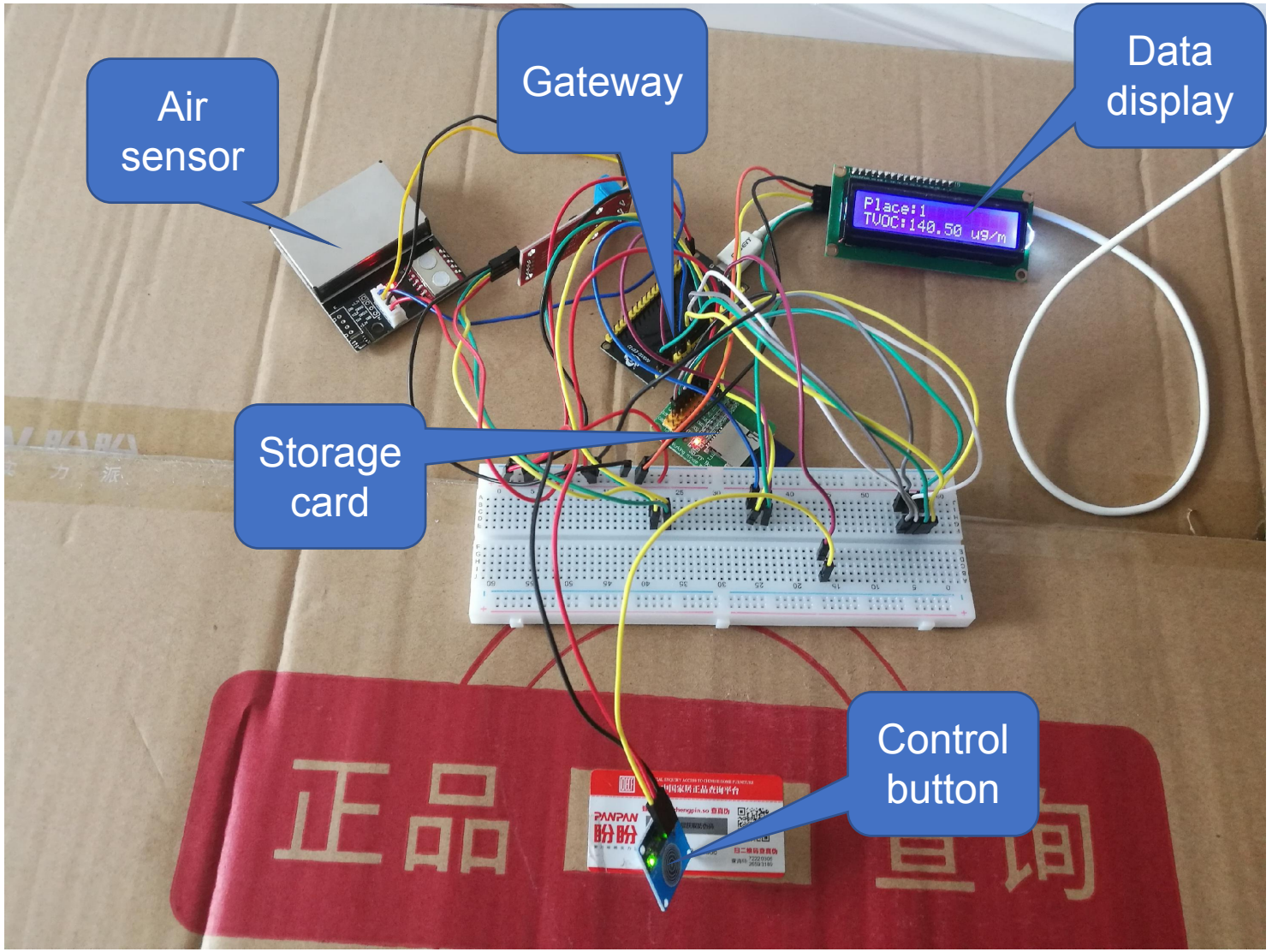
OPC UA Protocol

Innovative sensors

Case 1: house toxic gas monitoring

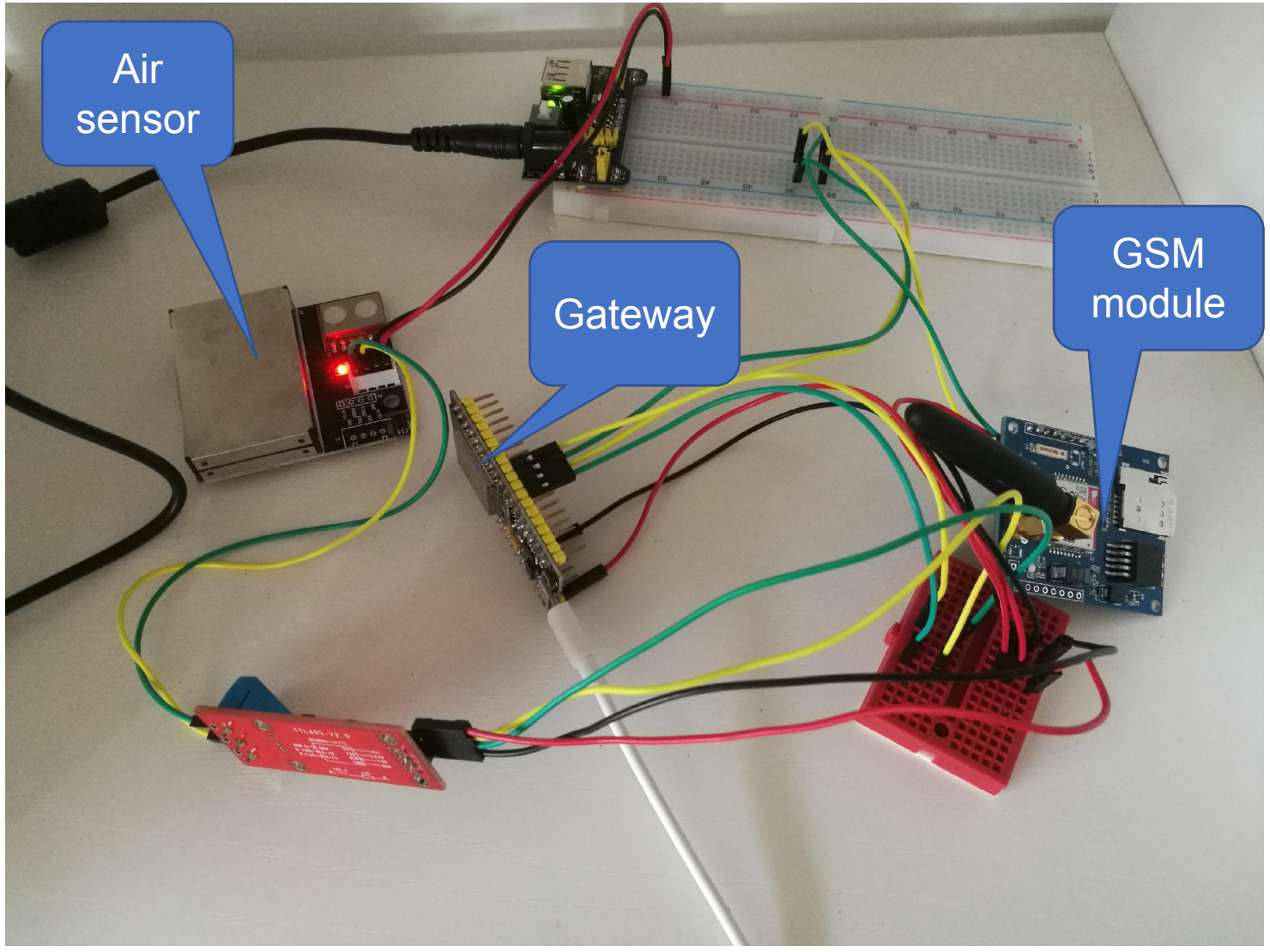


Case 1: house toxic gas monitoring



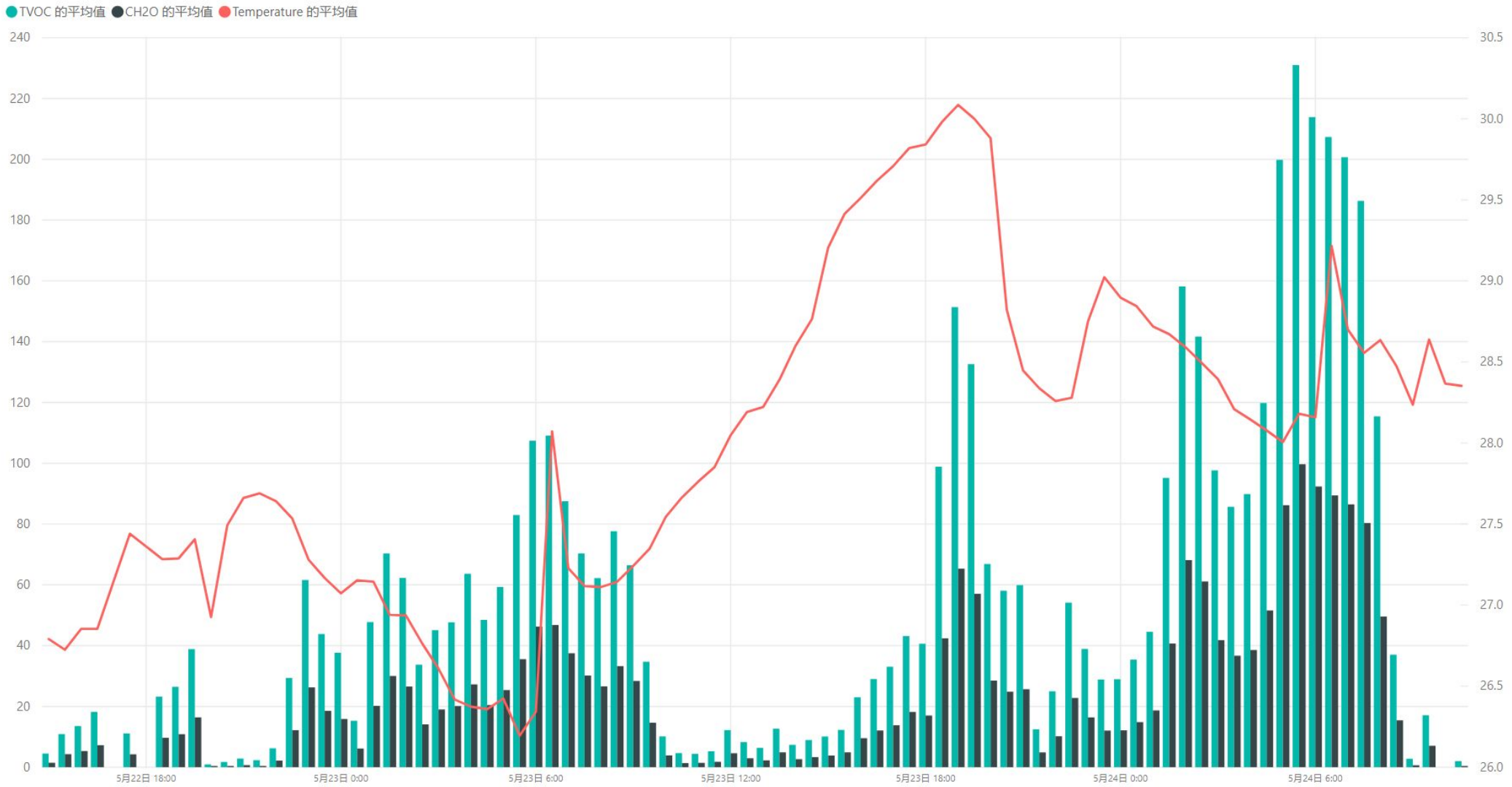
Version 1

Case 1: house toxic gas monitoring



Version 2

Case 1: house toxic gas monitoring



Case 2: smart pump demonstrator

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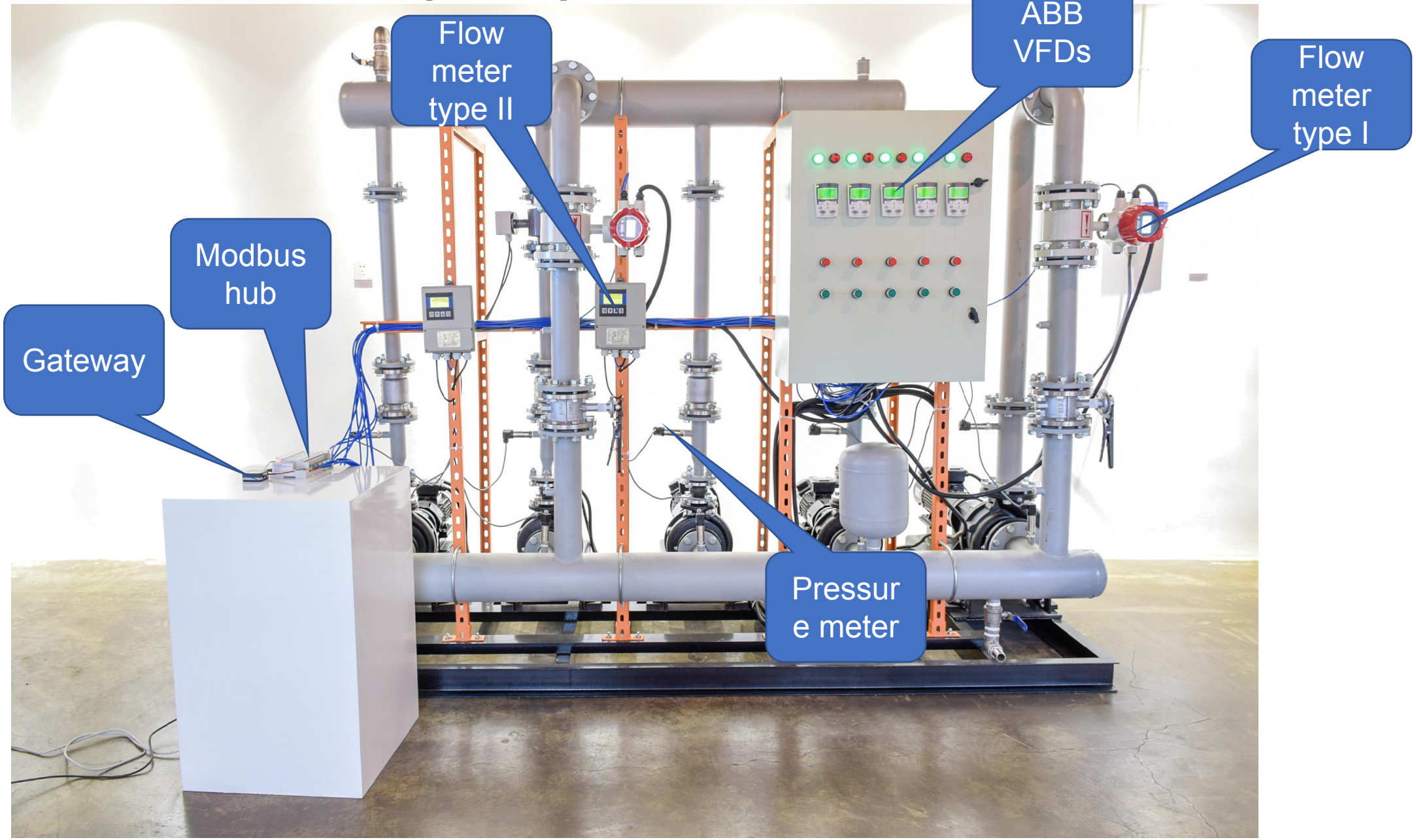
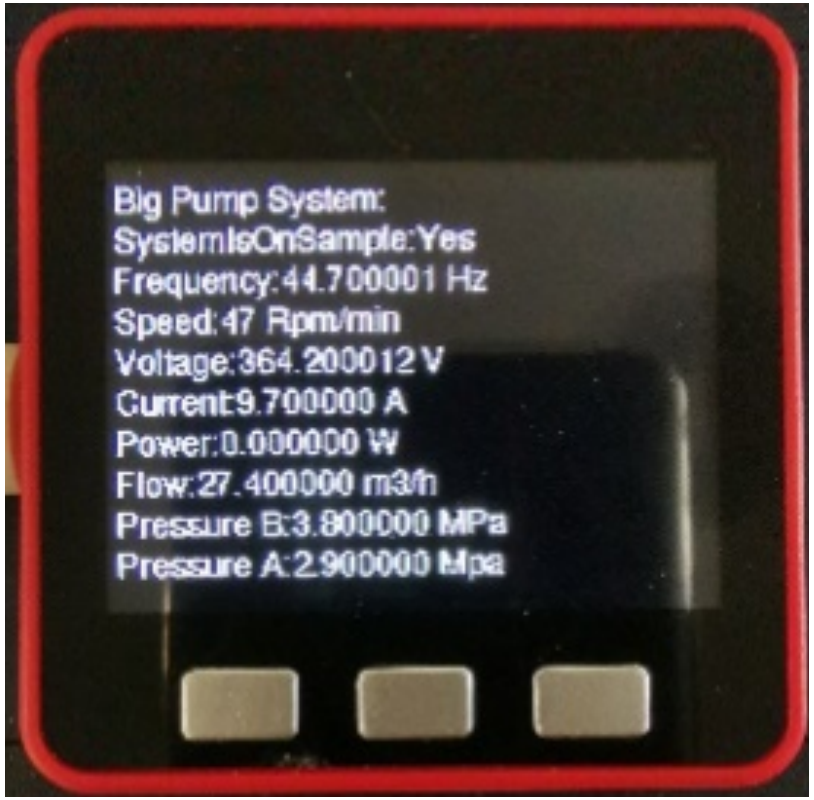
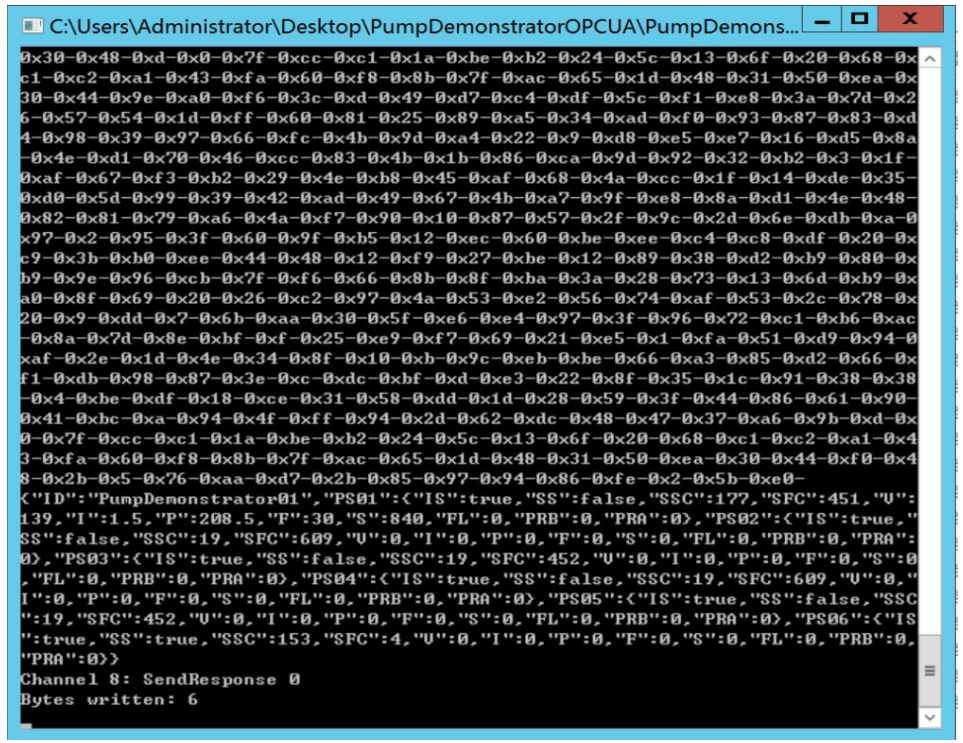


Case 2: smart pump demonstrator



Gateway with screen

Gateway connects to Modbus hub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c1-0xc2-0xa1-0x43-0xfa-0x60-0xf8-0x8b-0x7f-0xac-0x65-0x1d-0x48-0x31-0x50-0xea-0x
30-0x44-0x9e-0xa0-0xf6-0x3c-0xd-0x49-0xd7-0xc4-0xdf-0x5c-0xf1-0xe8-0x3a-0x7d-0x2
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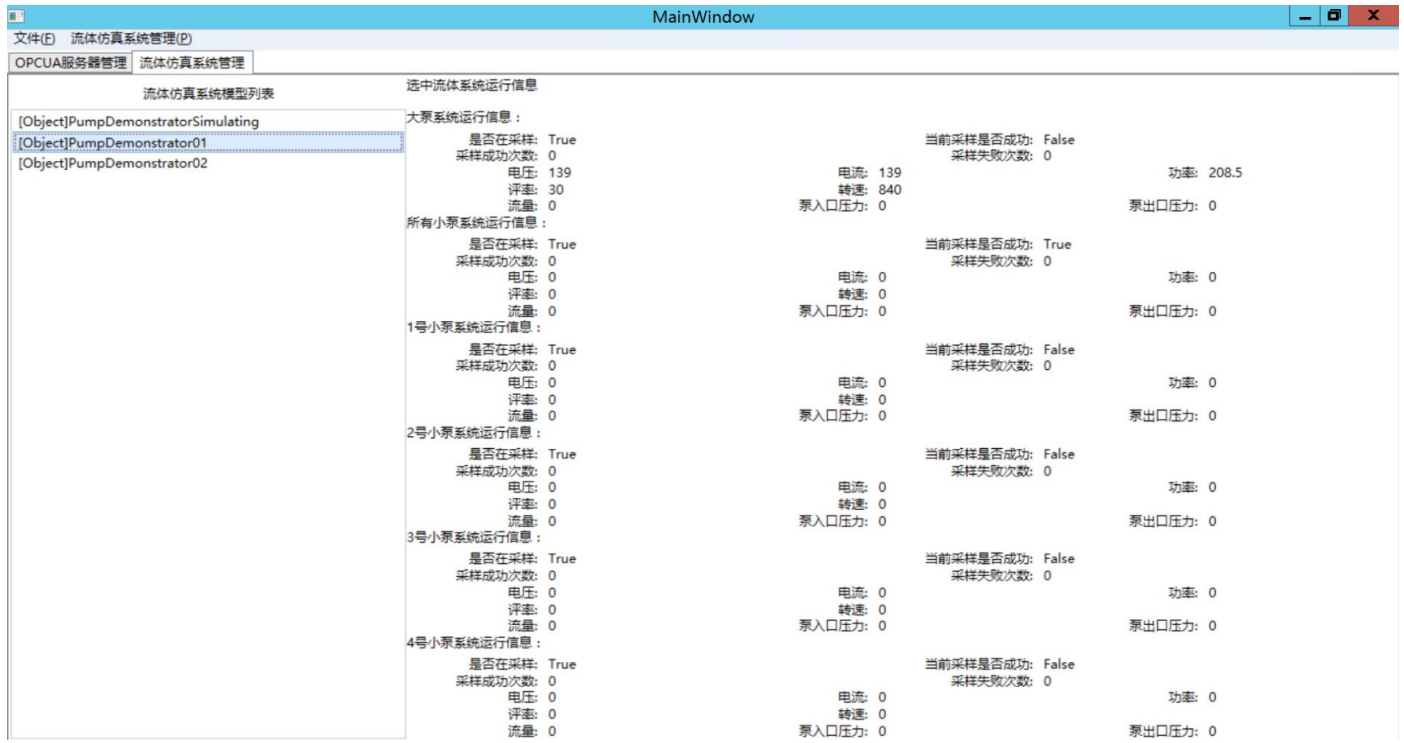
MainWindow
文件(F) 流体仿真系统管理(P)
OPCUA服务器管理 流体仿真系统管理
流体仿真系统模型列表
[Object]PumpDemonstratorSimulating
[Object]PumpDemonstrator01
[Object]PumpDemonstrator02
选中流体系统运行信息
大泵系统运行信息：
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采样成功次数: 0 采样失败次数: 0
电压: 139 电流: 139 功率: 208.5
评率: 30 转速: 840
流量: 0 泵入口压力: 0 泵出口压力: 0
所有小泵系统运行信息：
是否在采样: True 当前采样是否成功: True
采样成功次数: 0 采样失败次数: 0
电压: 0 电流: 0 功率: 0
评率: 0 转速: 0
流量: 0 泵入口压力: 0 泵出口压力: 0
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是否在采样: True 当前采样是否成功: False
采样成功次数: 0 采样失败次数: 0
电压: 0 电流: 0 功率: 0
评率: 0 转速: 0
流量: 0 泵入口压力: 0 泵出口压力: 0
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采样成功次数: 0 采样失败次数: 0
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评率: 0 转速: 0
流量: 0 泵入口压力: 0 泵出口压力: 0
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采样成功次数: 0 采样失败次数: 0
电压: 0 电流: 0 功率: 0
评率: 0 转速: 0
流量: 0 泵入口压力: 0 泵出口压力: 0
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采样成功次数: 0 采样失败次数: 0
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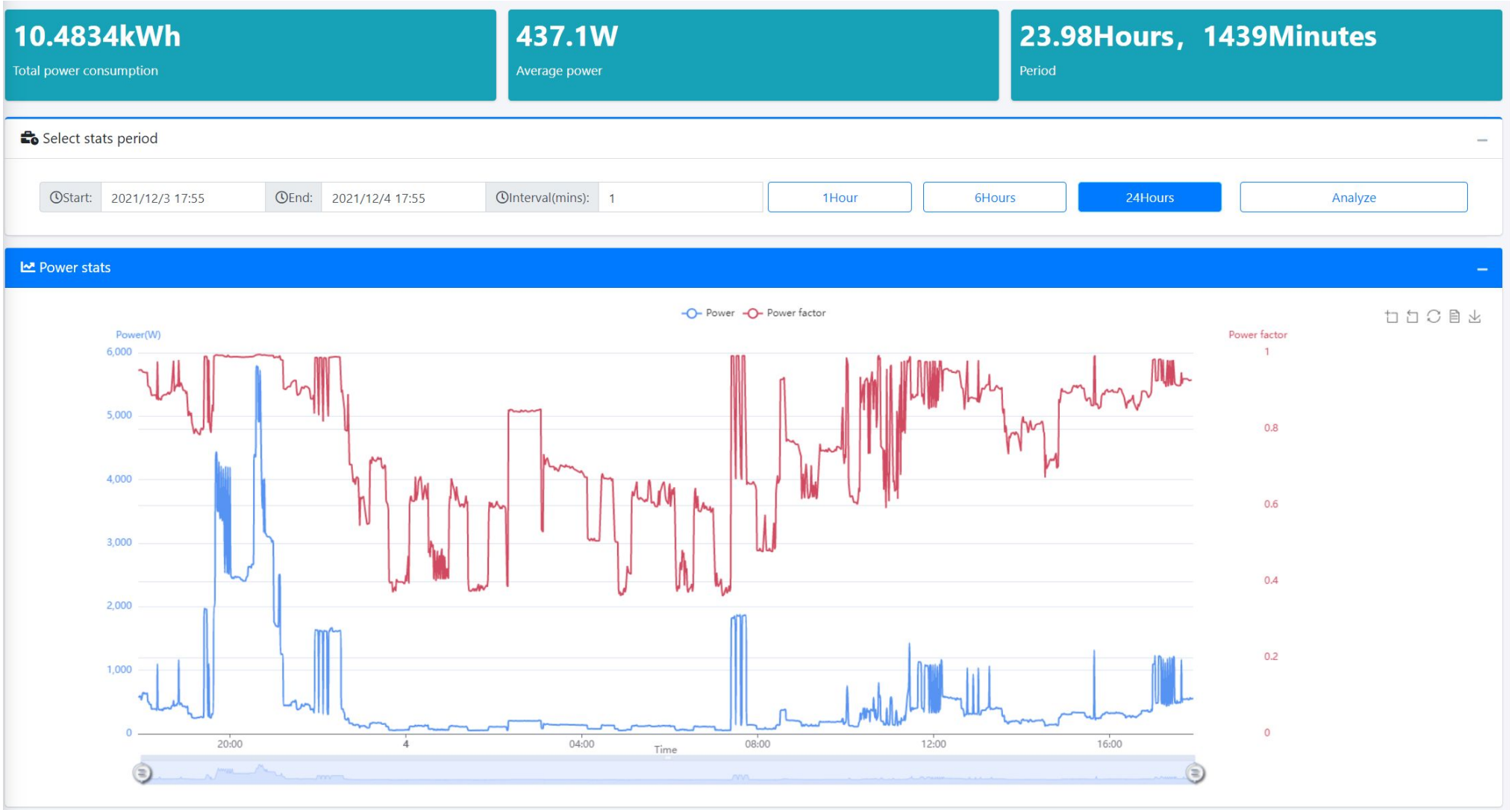
评率: 0 转速: 0
流量: 0 泵入口压力: 0 泵出口压力: 0

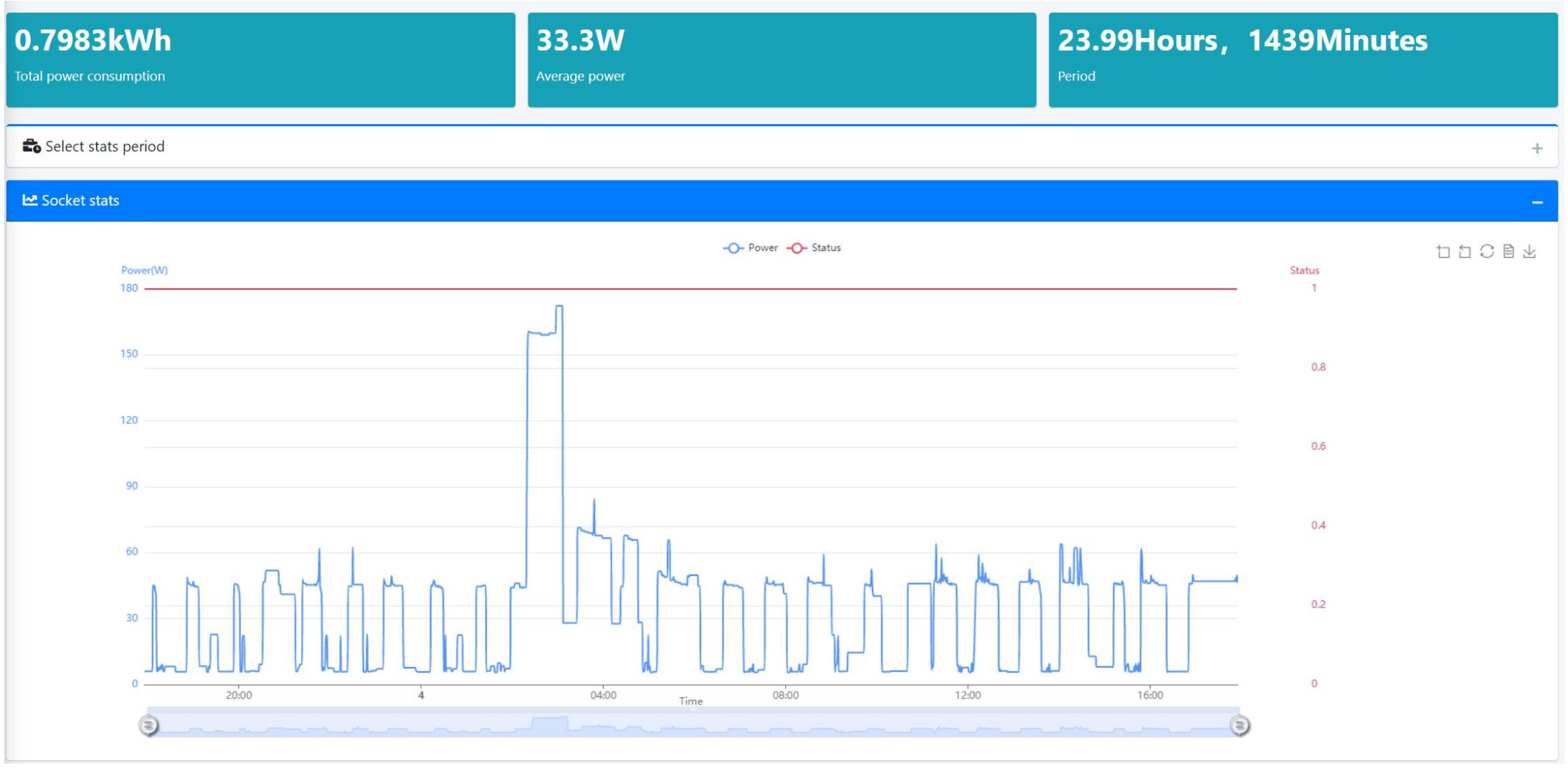
Case 3: Electricity monitoring

Smart socket

Total house energy stats

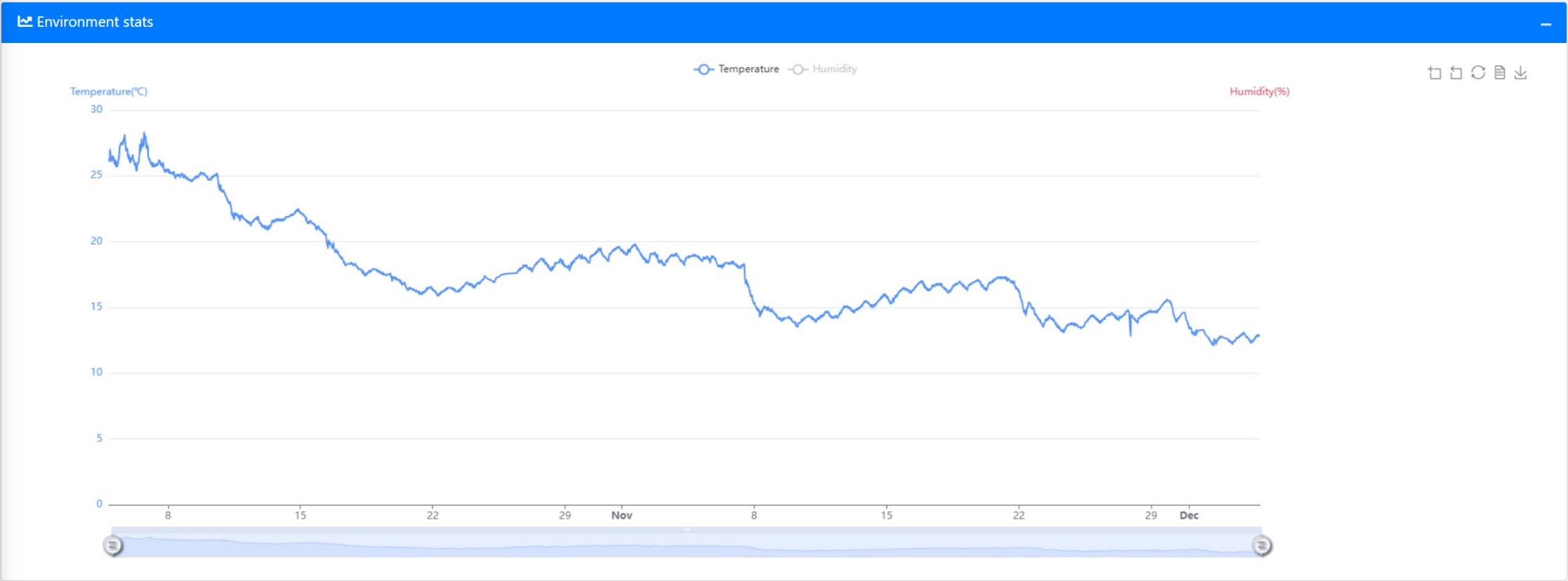


Refrigerator power stats



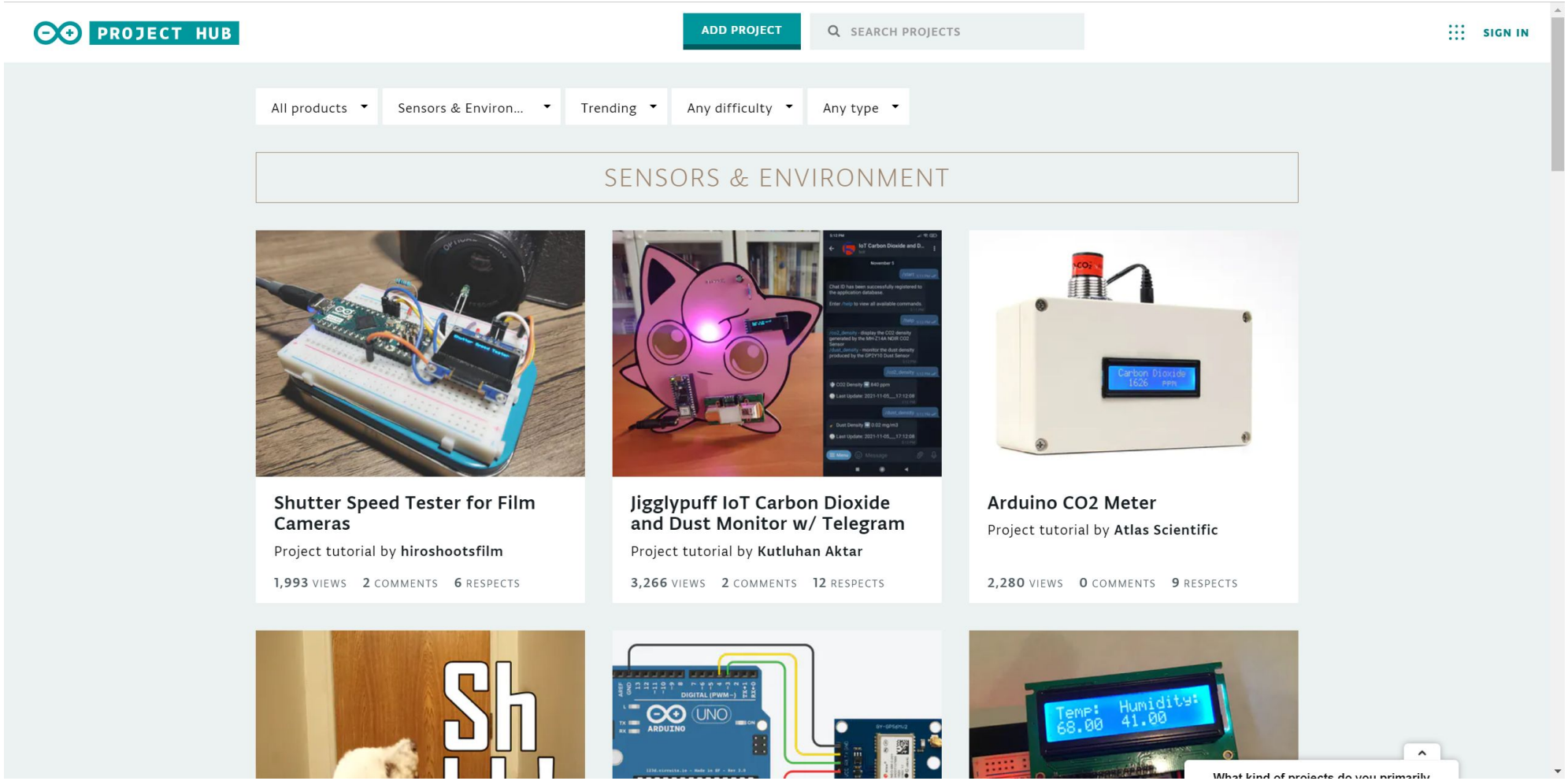
TV power stats

Environment stats - Temperature



Smart watering

How to start? - Arduino



https://www.arduino.cc/

Disadvantage of digitalization

- Extra development and deployment cost
- Extra system maintenance cost
- Engineering training and using
- How to extra the knowledge from the data?

Thank You !

Hu Bo

Director of Top10

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