EPICS Education at University

2017/05/16

Osaka City University

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EPICS Education at University

EPICS is a good software tool for education.

EPICS is an open source ← *important point!*
to construct the distributed control system.

EPICS is used, developed, and supported in worldwide.
 - There are many UI frameworks related to EPICS.
 - Many materials for users, beginners.
   Users forum, documentations in WWW, "test record", …
 - Many particle accelerators, telescopes and
   other large scientific experiments use EPICS
   to control the experimental devices.

EPICS Education at University

EPICS is a good software tool for education.

In Osaka City University, 4 groups, ~8 faculty members are working on high-Energy, cosmic-ray, and cosmology experiments. Some of the experiments (T2K, KAGRA, Belle2..) use EPICS.

Users forum, documentations in WWW, "test record", …

- Many particle accelerators, telescopes and
  other large scientific experiments use EPICS
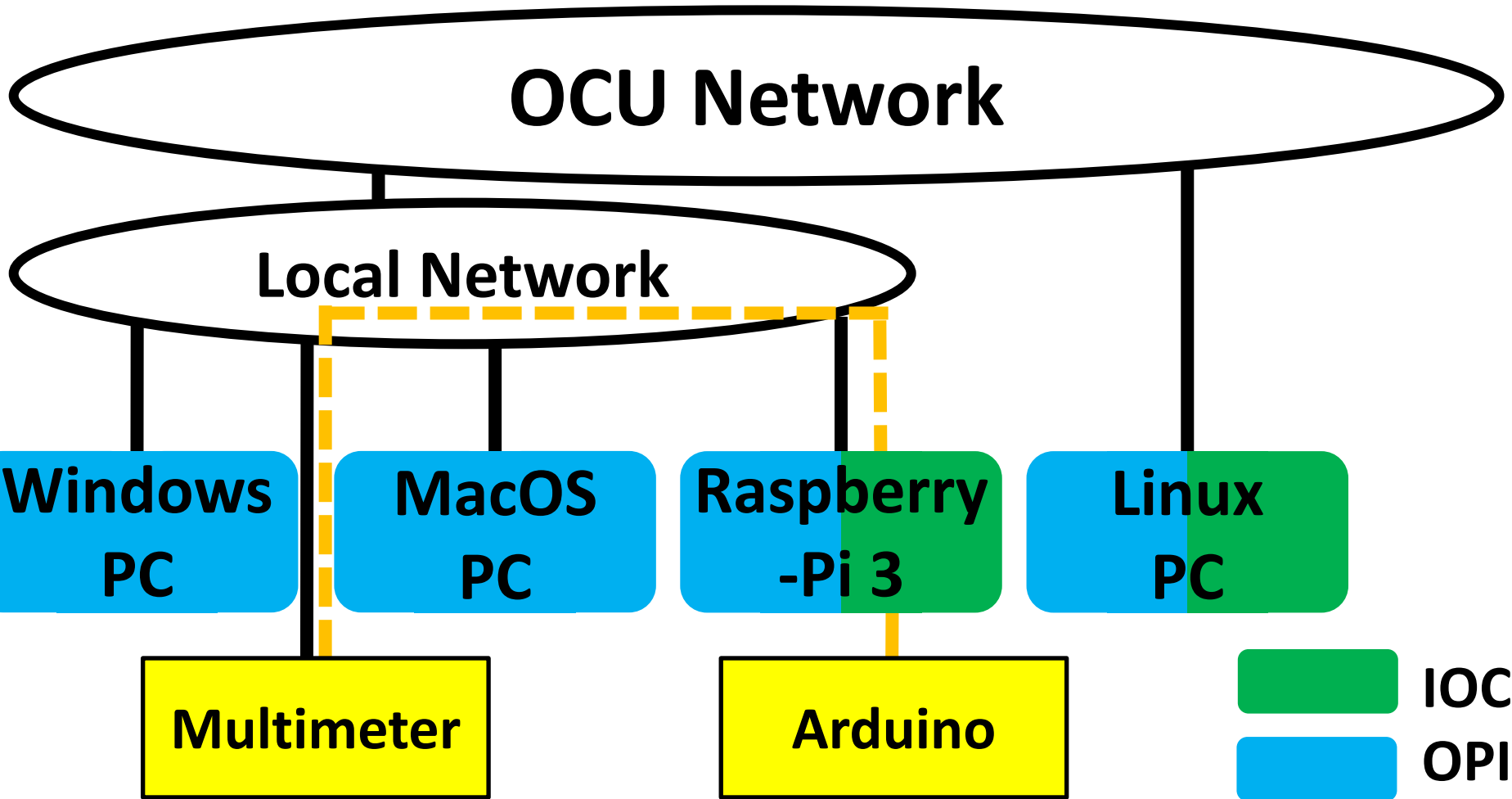 to control the experimental devices.

EPICS Education at University

EPICS is a good software tool for education.

In Osaka City University,

1. We construct the device control system using
    PC's (Windows, MacOS, Linux) and RPi3's
       for the undergraduate student education.

2. There was a lecture / hands on
    using RPi3 & Arduino,
       for (under) graduate students, and staffs.

1. Device Control System in OCU

OCU Network

Local Network

Windows PC

MacOS PC

Raspberry -Pi 3

Linux PC

Multimeter

Arduino

IOC

OPI

For undergraduate student education,
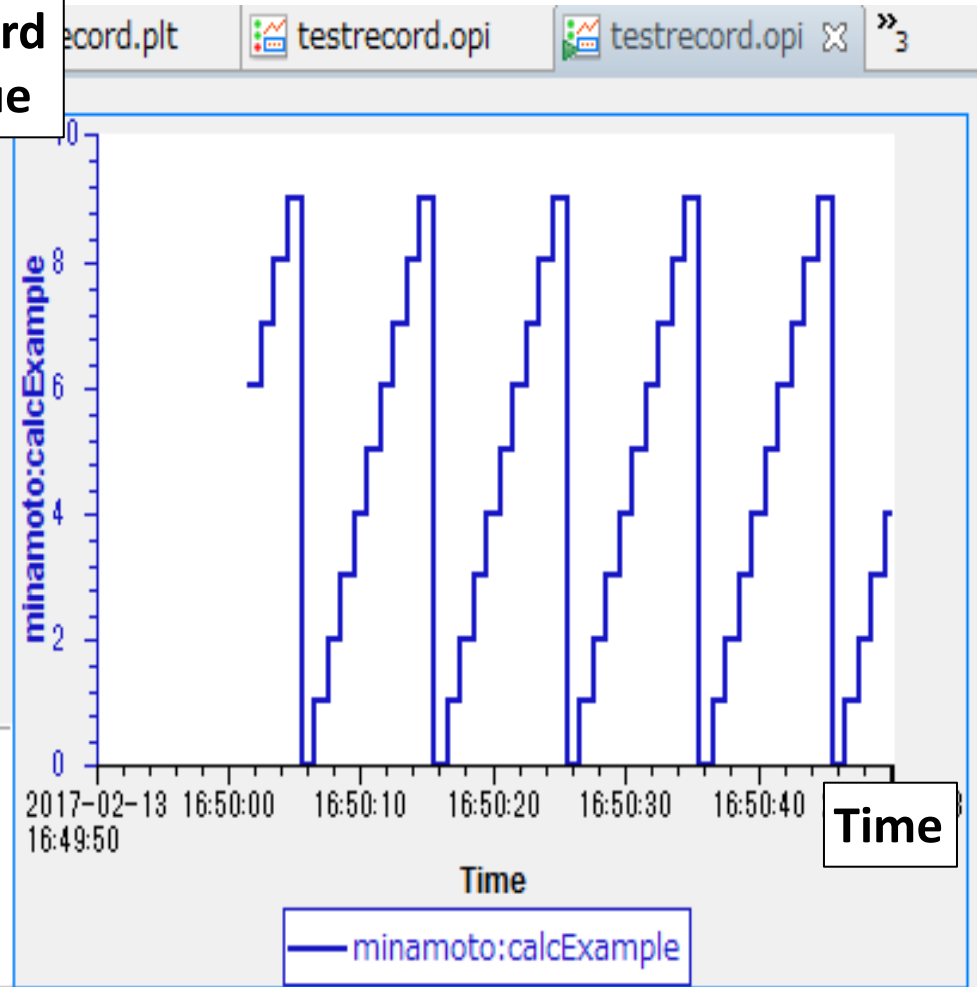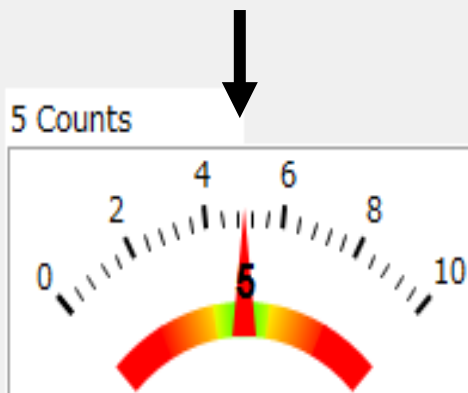we construct the control system based on EPICS.

OPI software : CSS
Test Record Monitoring 1

We install CSS in Windows and MacOS PCs and monitor the test record generated in a Linux PC.

Record Value

Current value of the test record

Time

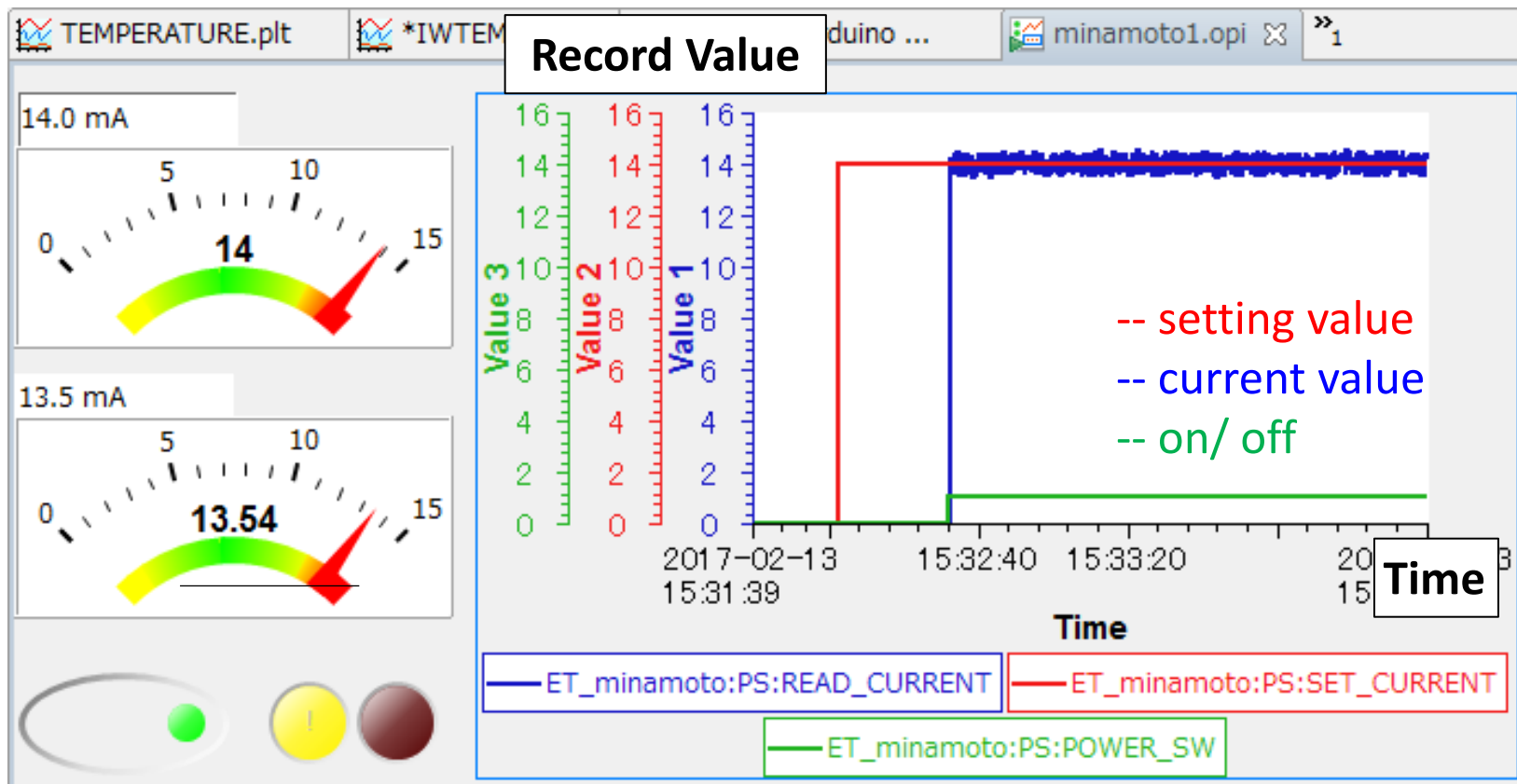5 Counts

minamoto:calcExample

CSS UI made by an under graduate student.

D. Minamoto

OPI software : CSS
Test Record Monitoring 2

Using a calc record, we make a set of test records to simulate PW supply.

D. Minamoto

IOC : Raspberry-Pi3

We install EPICS in a Raspberry-Pi3 (OS = Raspbian) to control devices (Arduino and Digital-Multimeter).
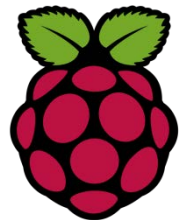

Raspberry Pi (RPi)

⬇

Small single-board computer developed in the UK by the Raspberry Pi Foundation

- **A 1.2GHz 64-bit quad-core ARMv8 CPU**
- **1GB RAM**
- **802.11n Wireless LAN**
- **Ethernet port**
- **4 USB ports**
- **HDMI port**
- **40 GPIO pins**, etc,,

IOC : Raspberry-Pi3

We install EPICS in a Raspberry-Pi3 (OS = Raspbian) to control devices (Arduino and Digital-Multimeter).

DI/DO ports

USB

AI ports

Arduino UNO

Arduino board

A microcontroller board based on the Atmel 8-bit AVR

(ATmega328P for Arduino UNO)

- 10-bit ADC
- 14 Digital I/O pins
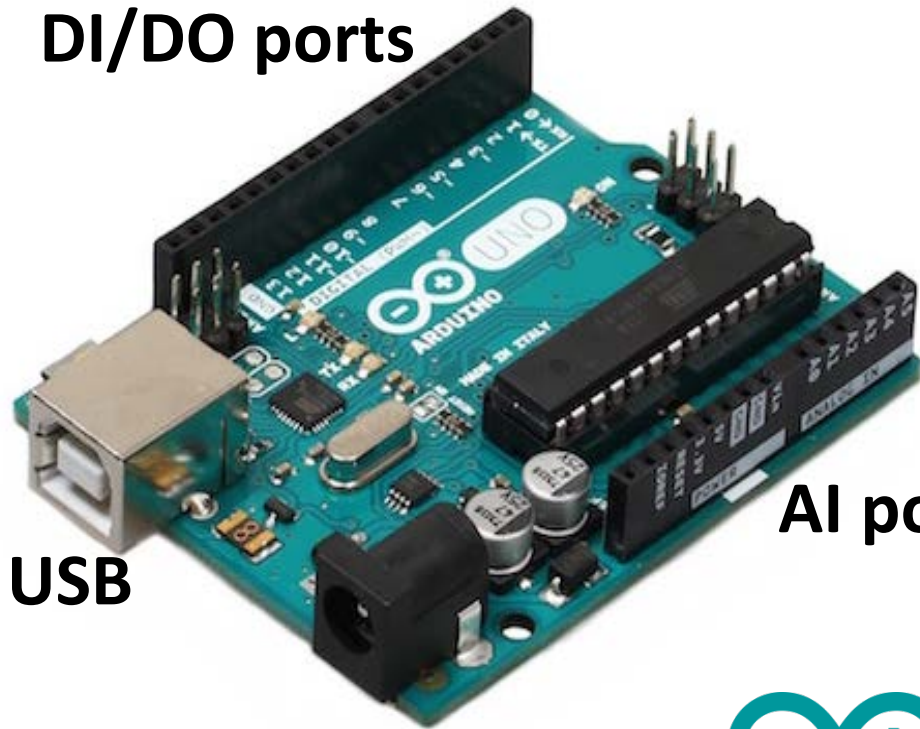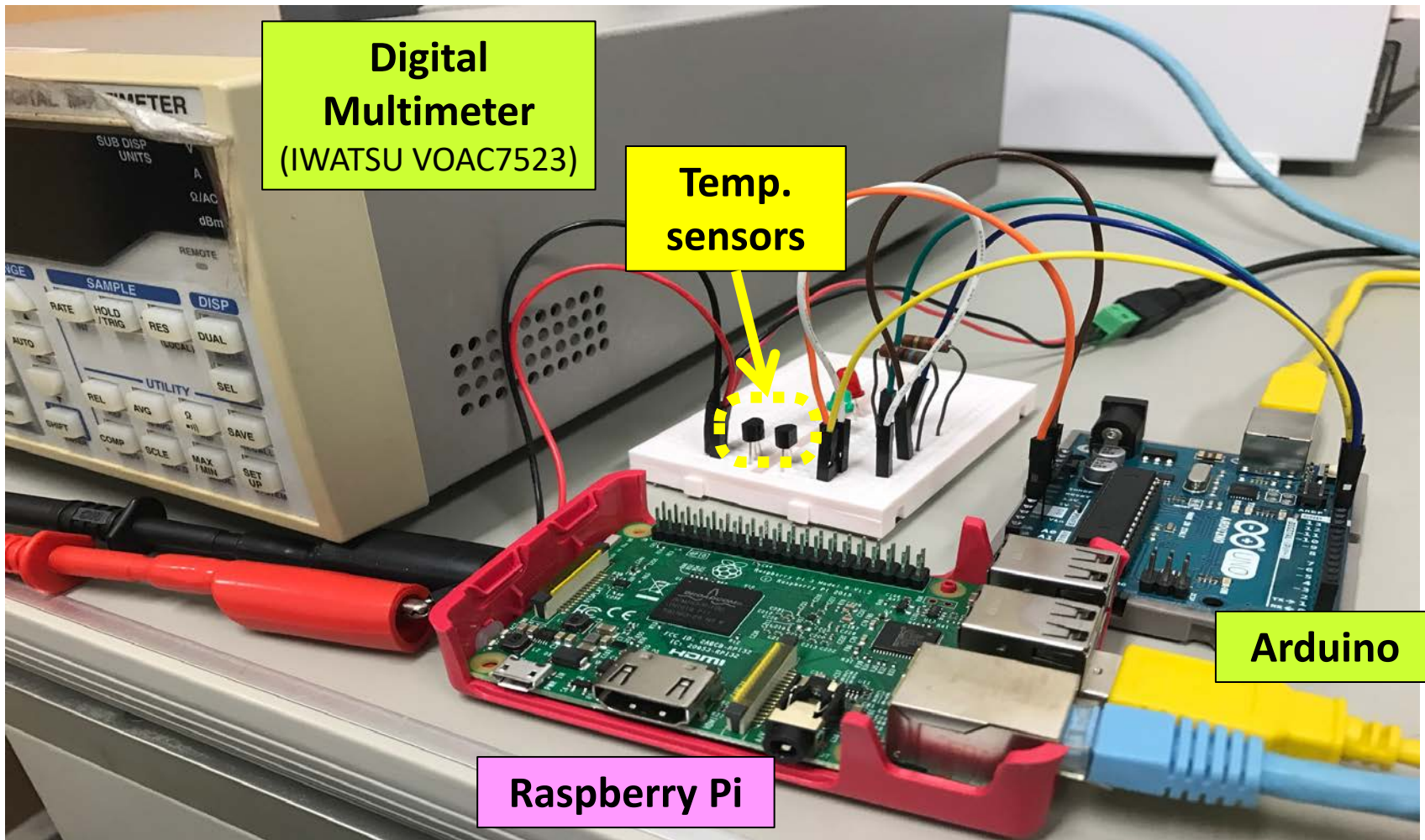- 6 Analog inputs
- A 16 MHz quartz crystal
- 1 USB connection
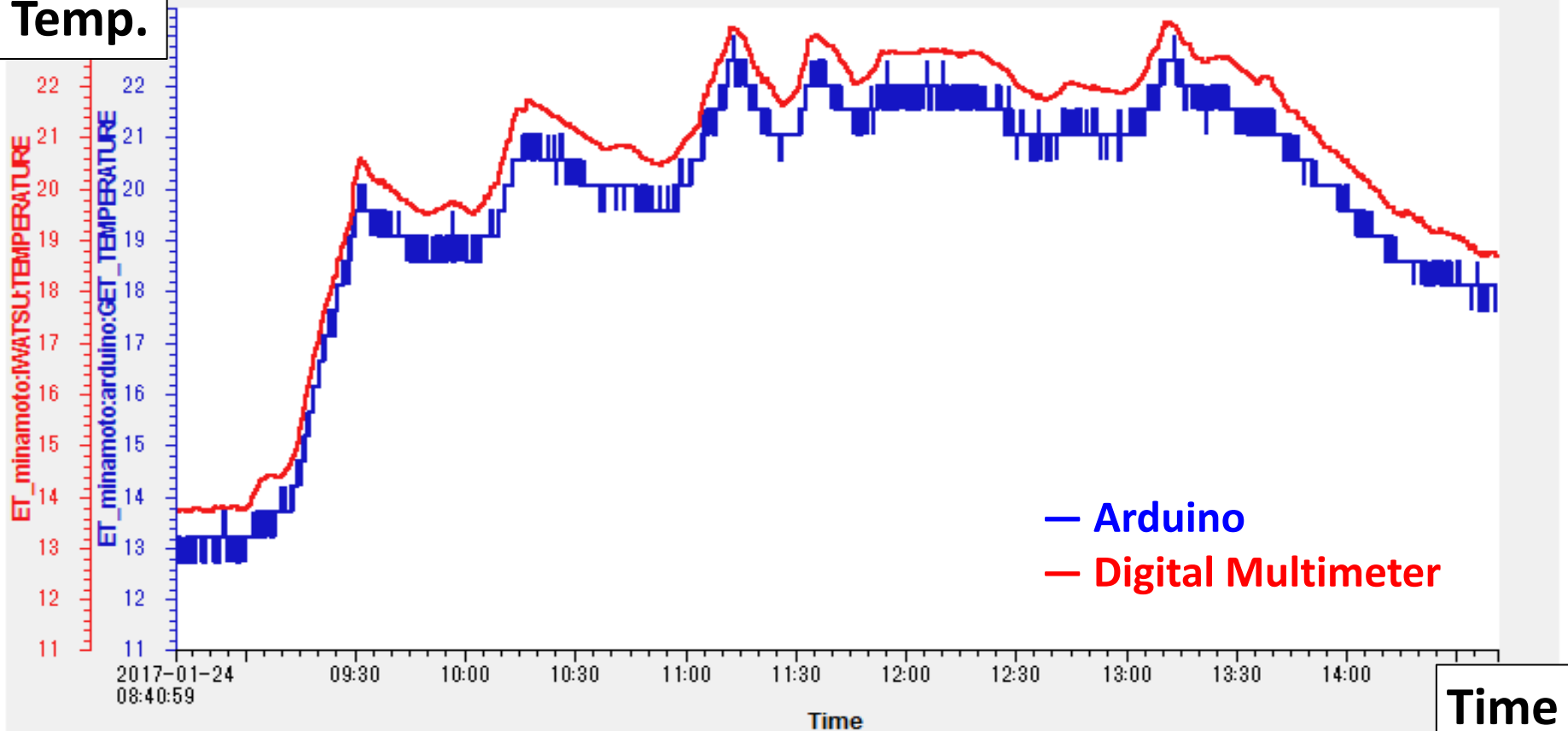
IOC : Raspberry-Pi3

We install EPICS in a Raspberry-Pi3 (OS = Raspbian)
to control devices (Arduino and Digital-Multimeter).

**Raspberry
Pi 3**

USB

Ethernet

Arduino

**Digital
Multimeter**

**Temp.
sensor**

**Temp.
sensor**

Temp. Sensor (LM35DZ)
1 degree = 10mV

- **Arduino UNO**
  10bit ADC for 5V full range
  ΔV = ~5mV $\rightarrow$ ΔT = 0.5 degree

- **Digital Muitlimeter**
  (IWATSU VOAC7523)
  ΔV = 10mV $\rightarrow$ ΔT = 0.001 degree

IOC : Raspberry-Pi3

We install EPICS in a Raspberry-Pi3 (OS = Raspbian) to control devices (Arduino and Digital-Multimeter).

Digital Multimeter (IWATSU VOAC7523)

Temp. sensors

Arduino

Raspberry Pi

IOC : Raspberry-Pi3

Temperature data from Arduino and digital multimeter are monitored using CSS

Arduino ΔT = 0.5 degree

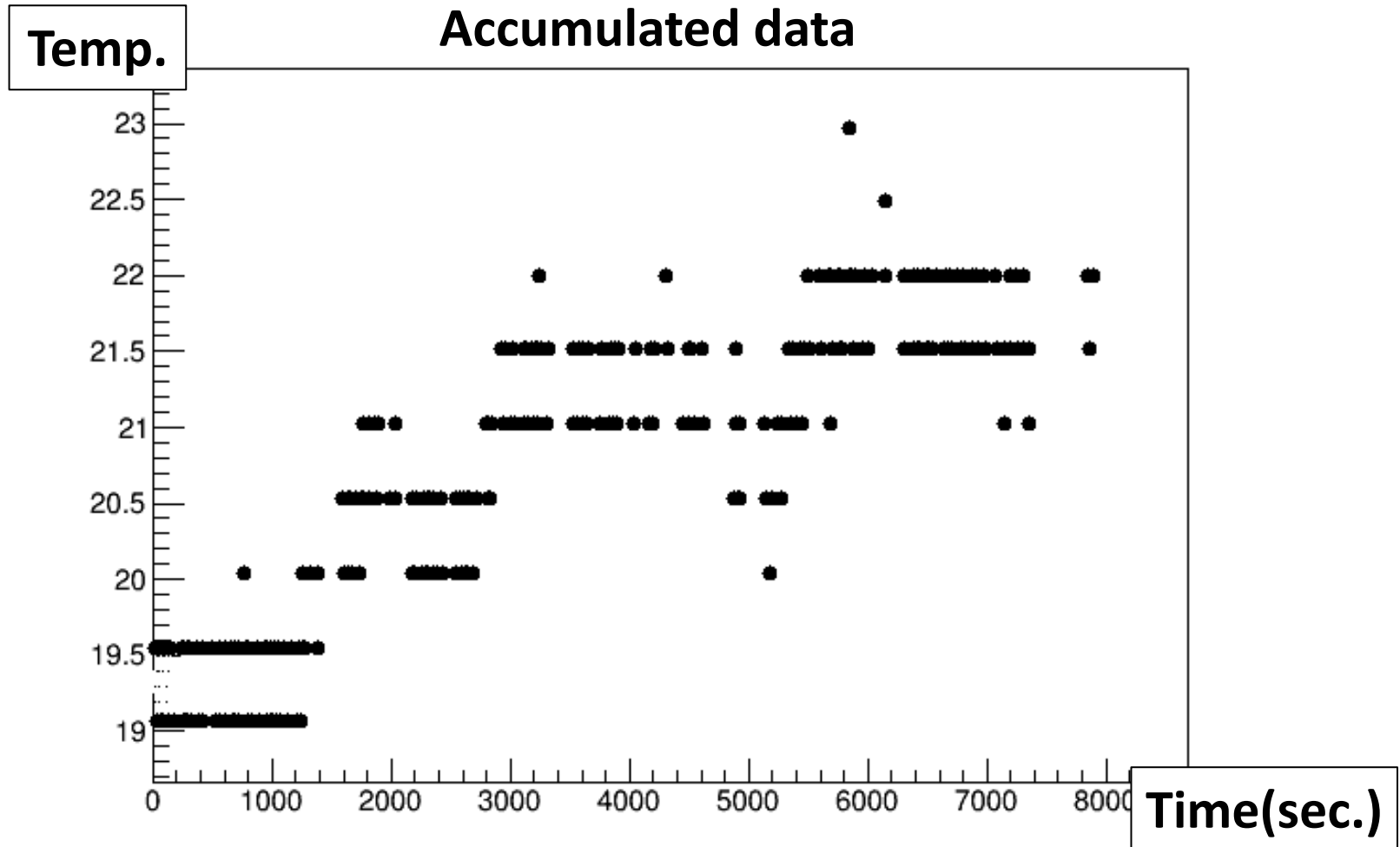Digital Muitlimeter ΔT = 0.001 degree

D. Minamoto

OPI : Raspberry-Pi3

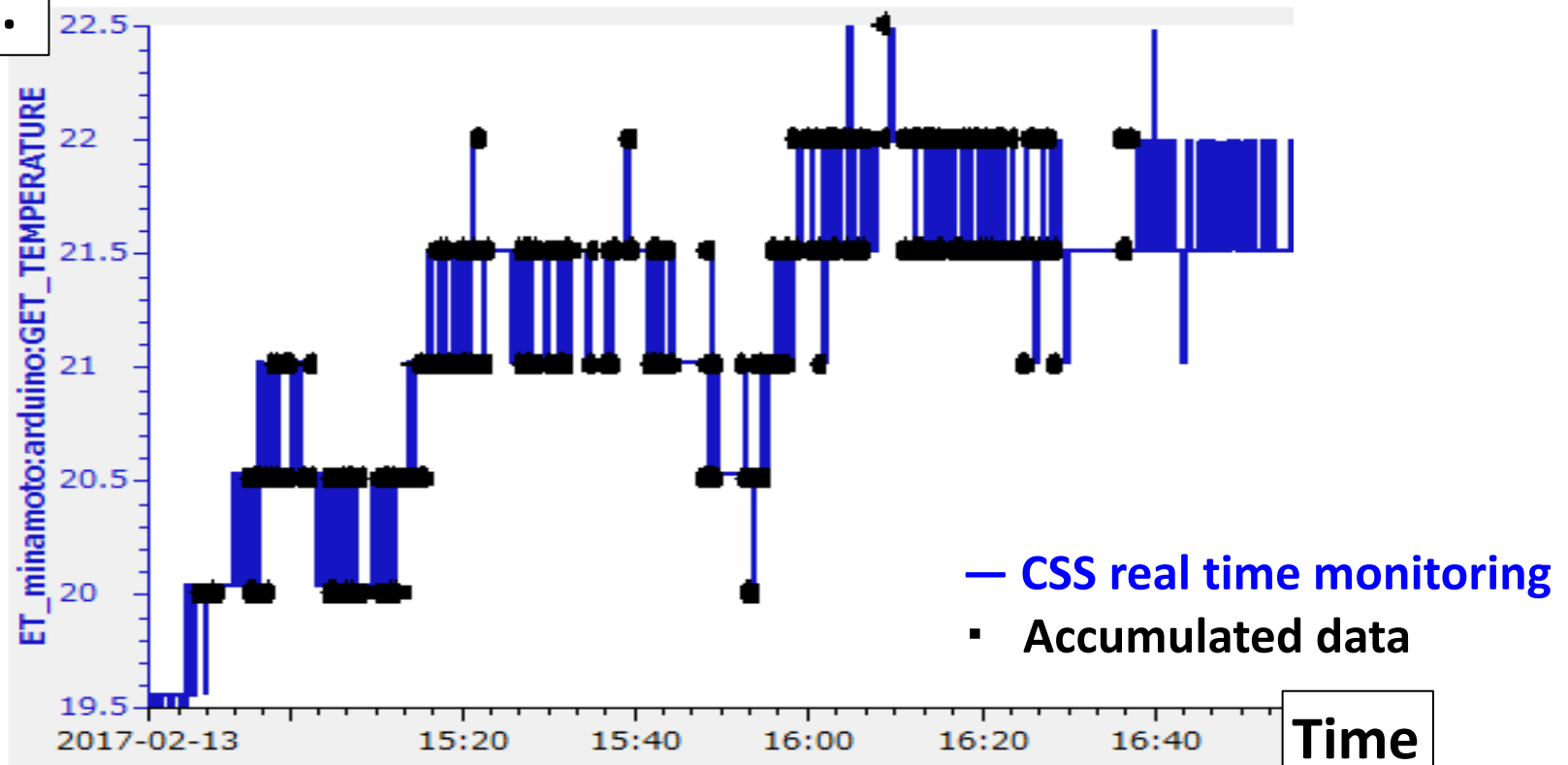**Temperature data is accumulated in RPi3. (As a text file)**

Accumulated data

Temp. / Time(sec.)

D. Minamoto

OPI : Raspberry-Pi3

Temperature data is accumulated in RPi3. (As a text file)

Overlay the accumulated data to the real-time monitoring

— CSS real time monitoring
· Accumulated data

D. Minamoto

2. EPICS lecture / hands on at OCU

There was a 2-day lecture + hands on
- Using RPi3 & Arduino
- EPICS and PythonCA
- For (under) graduate students, and staffs
- by N.Yamamoto (J-PARC/KEK)

Raspberry Pi 3	USB	Arduino		Various sensors on the Arduino shield (ext. board)

The same EPICS training kit
for the hands on yesterday .

Arduino shield(ext. board) with Bread board for EPICS training

N. Yamamoto (KEK/J-PARC)

Includes
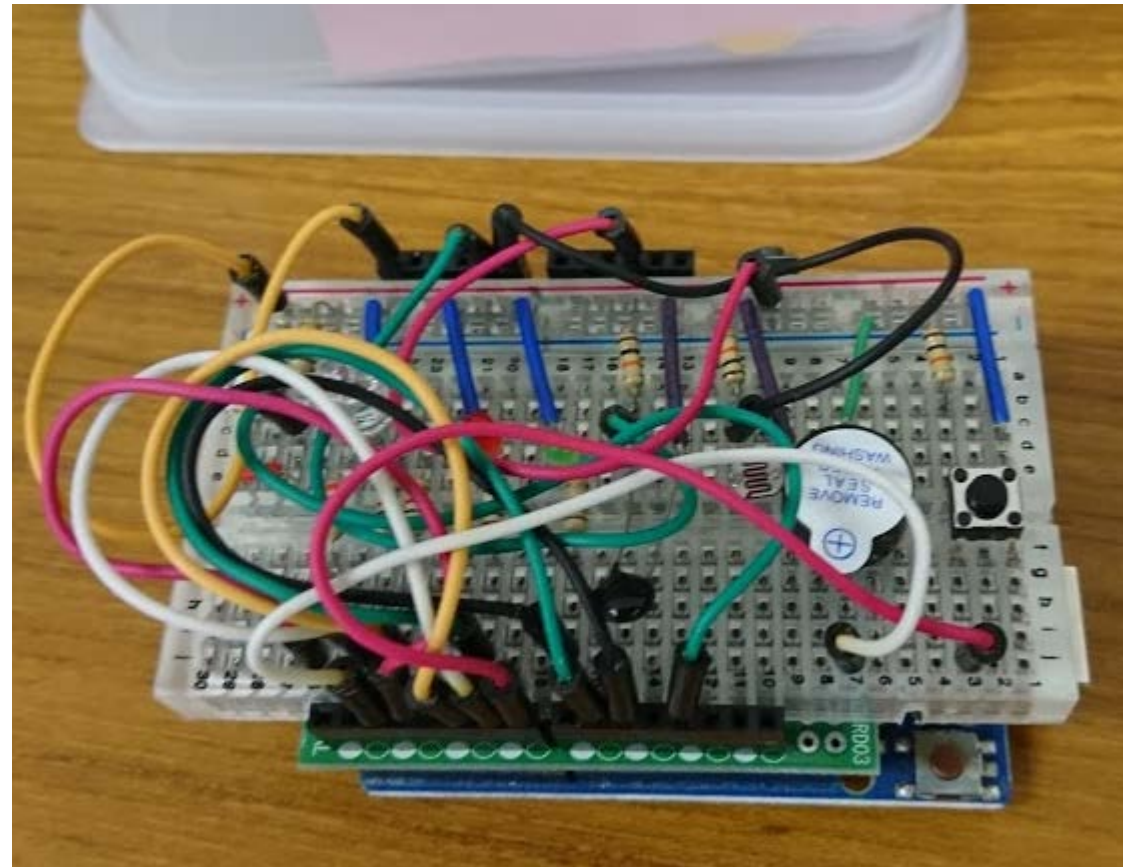1 TriColor LED (RGB)
2 LEDs (Red, Green)
1 Buzzer
1 Push Switch
1 Thermistor
1 CdS (Luminance sensor)
1 level Switch

~5,500 JPY
Including Arduino

EPICS Hands on @ OCU
by N.Yamamoto (KEK/J-PARC)

2017 Feb. at OCU

Summary

In Osaka City University,

- We construct the device control system based on EPICS with Windows, MacOS, Linux, PCs and RPi3 for under graduate student education.

- There was an EPICS lecture/hands on using RPi3 & Arduino for (under) graduate students and staffs.

EPICS + RPi3 + Arduino → good tools for education!!

This fiscal year, in my class for graduate students, I introduce EPICS for device control training.