Making New Tracking Simulator with Arduino and LabVIEW

- For student experiment of Human Engineering -

September 2nd , 2016
Ryuta Mogi, Education Experiment Support Center

Outline

① Motivation

② Intro to the existing student experiment

- Subject of student experiment
- The existing tracking simulator

③ New tracking simulator I designed

- Planning
- Intro to Arduino and LabVIEW

④ Issues and Summary

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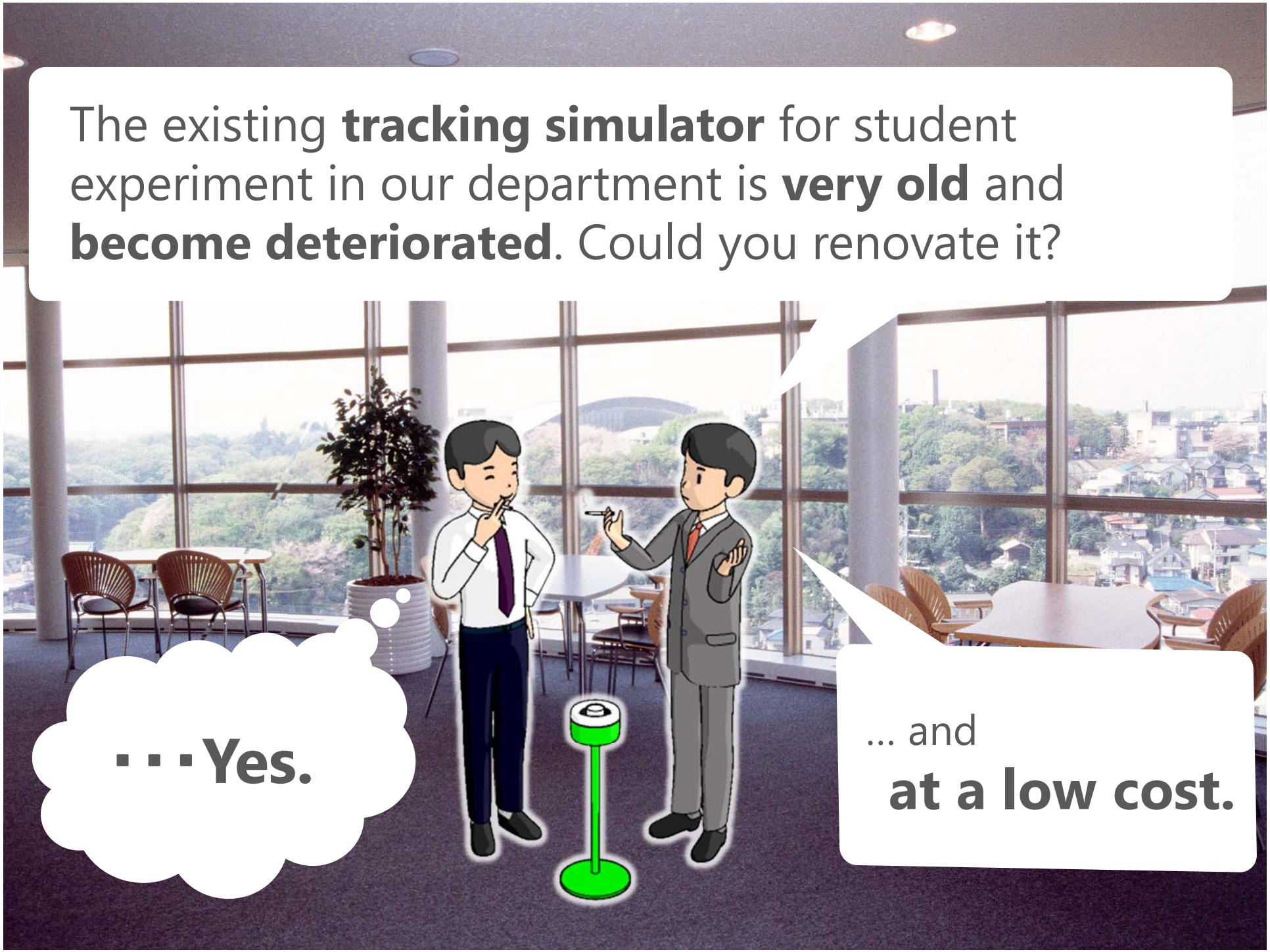
④ Issues and Summary


The existing **tracking simulator** for student experiment in our department is **very old** and **become deteriorated**. Could you renovate it?
・・・Yes.
... and
at a low cost.

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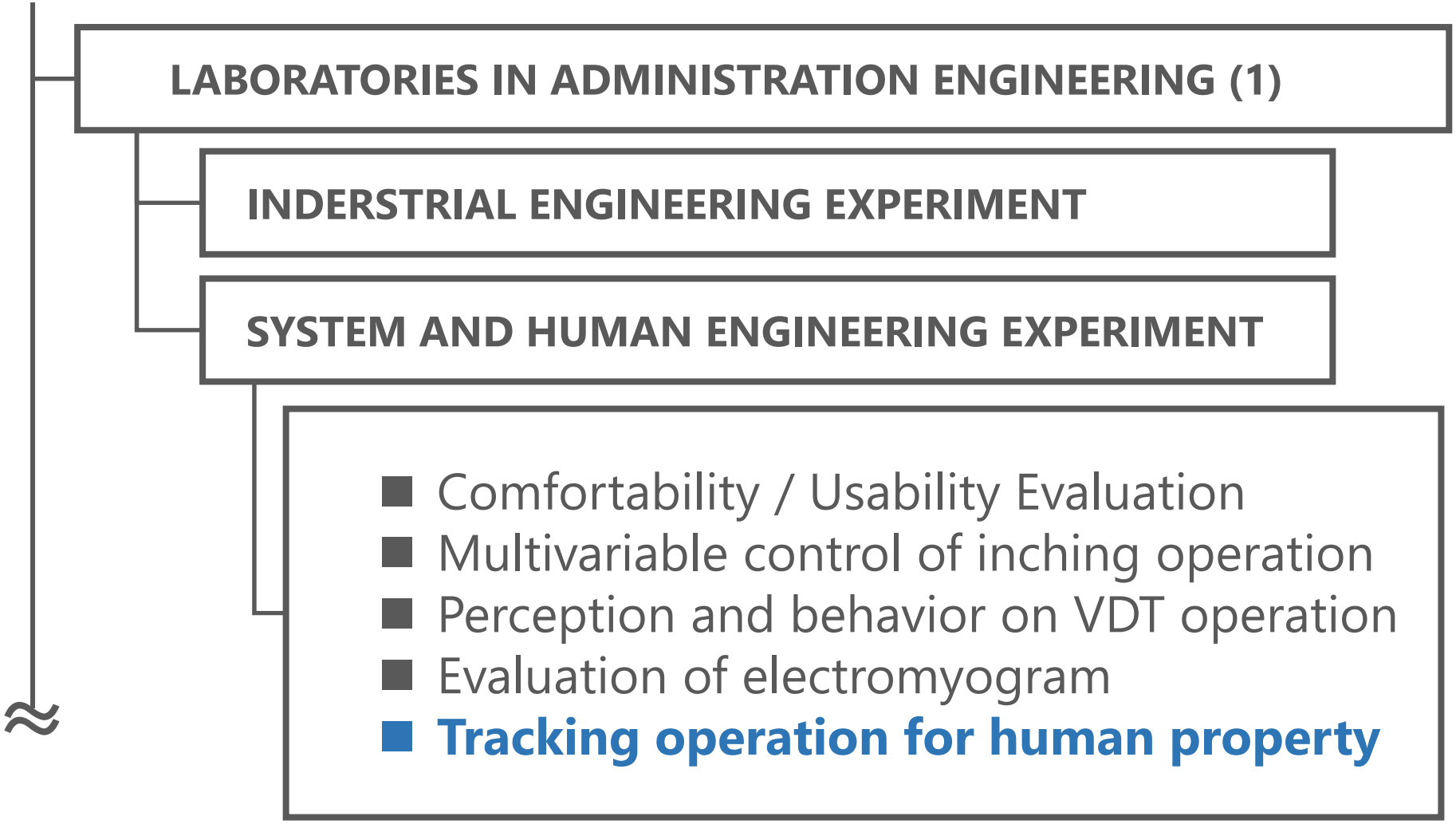
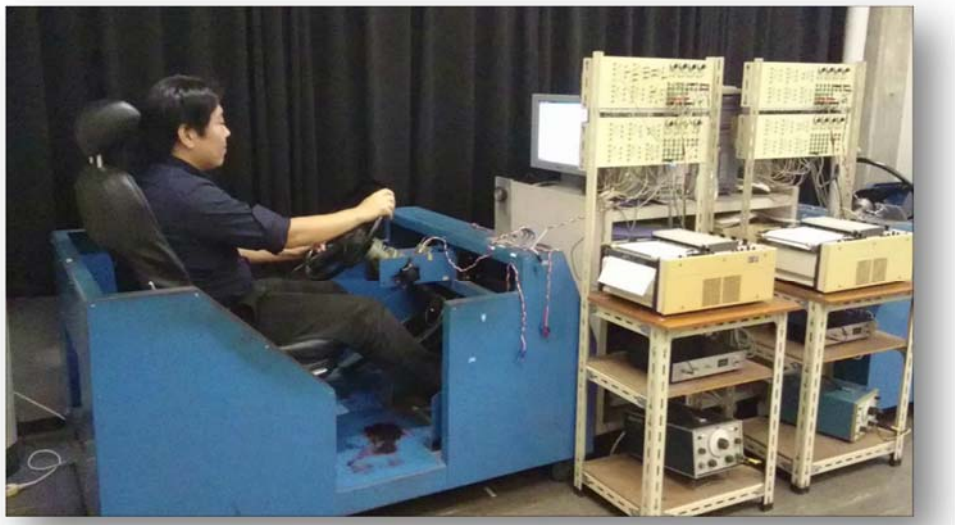
Experiments of
department of Administration Engineering

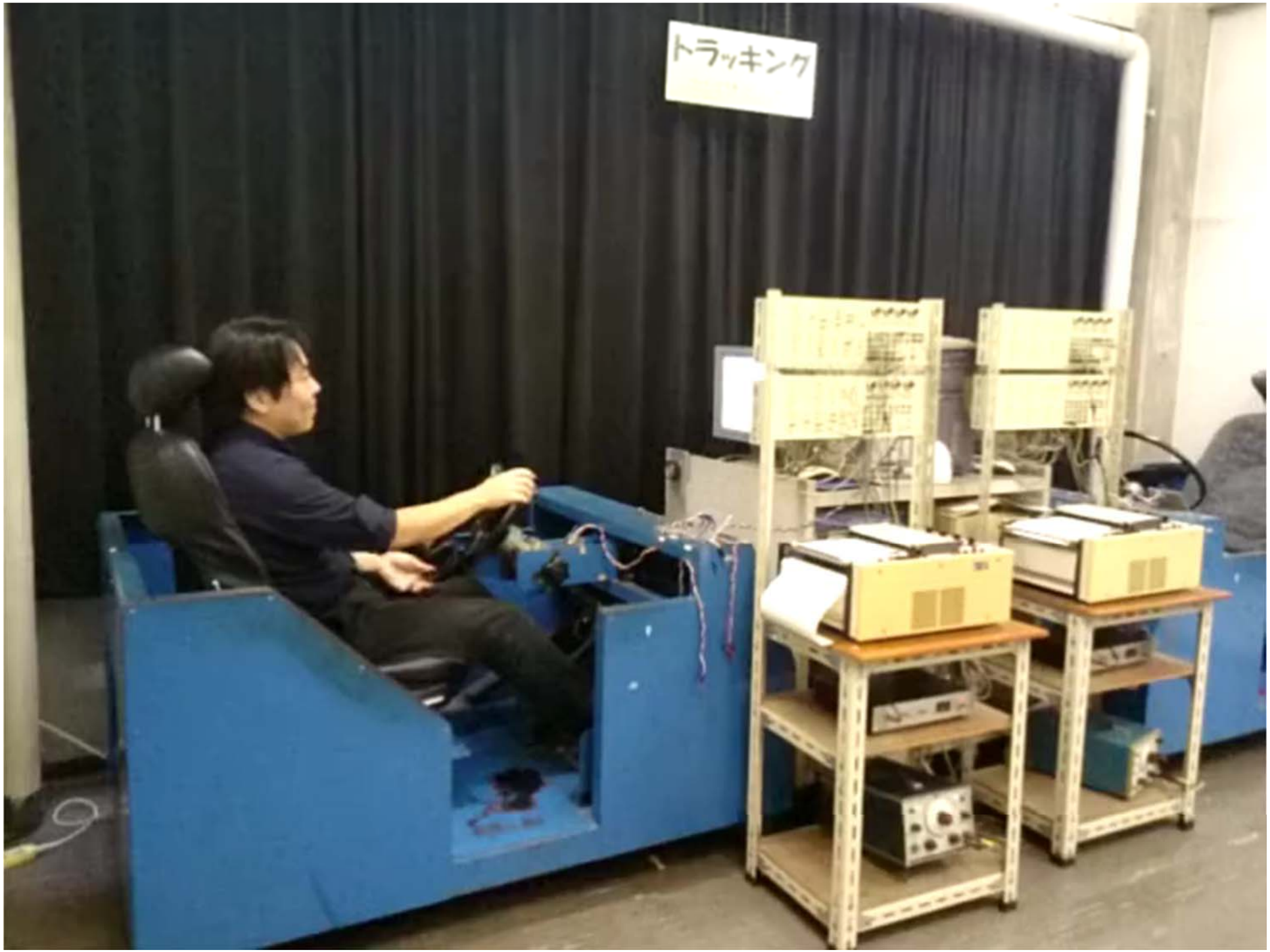


The objective of "tracking operation for human property"

- To study human's **control** capability, perception, cognition, and motion
- To study quality of **control** by various operational conditions and factors.



tracking simulator

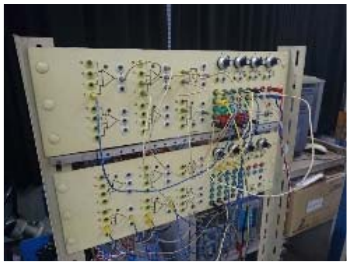

トラッキング

Existing facility

Human

Input handling devices
（wheel, pedal, lever, dial）

Strip-chart recorder



Analog computer
Electronic circuit

- proportional control
- integral control
- primary delay control

Wave generator
（sine wave, random wave

Display

Microsoft Visual Basic 6.0 SP6 Professional Edition

A/D converter
（PCI Bus）

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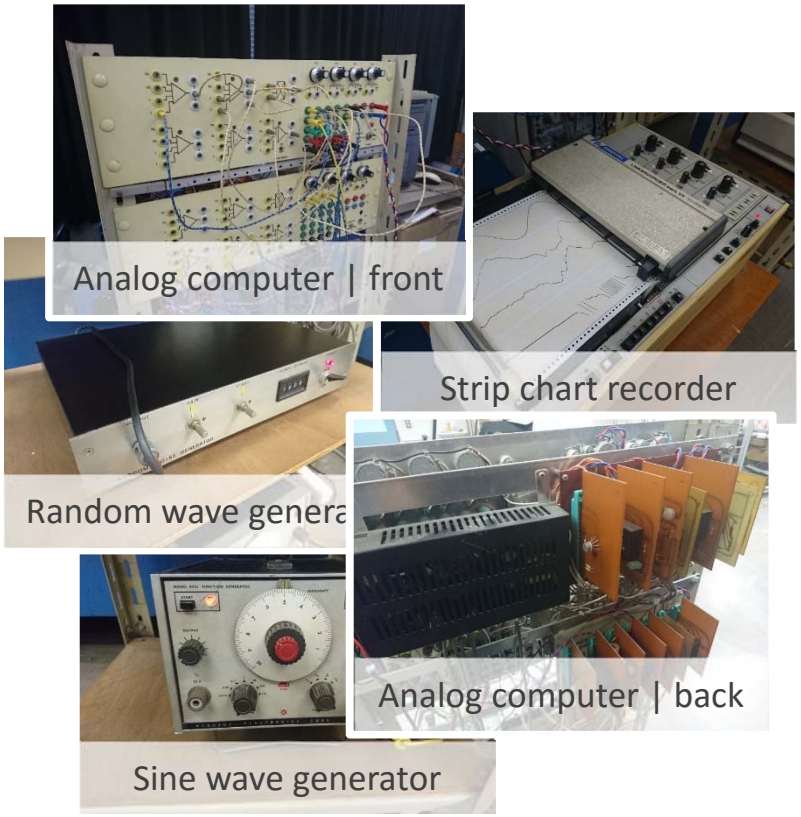
④ Summary and future plans

Planning

New facility I planned



Analog instruments

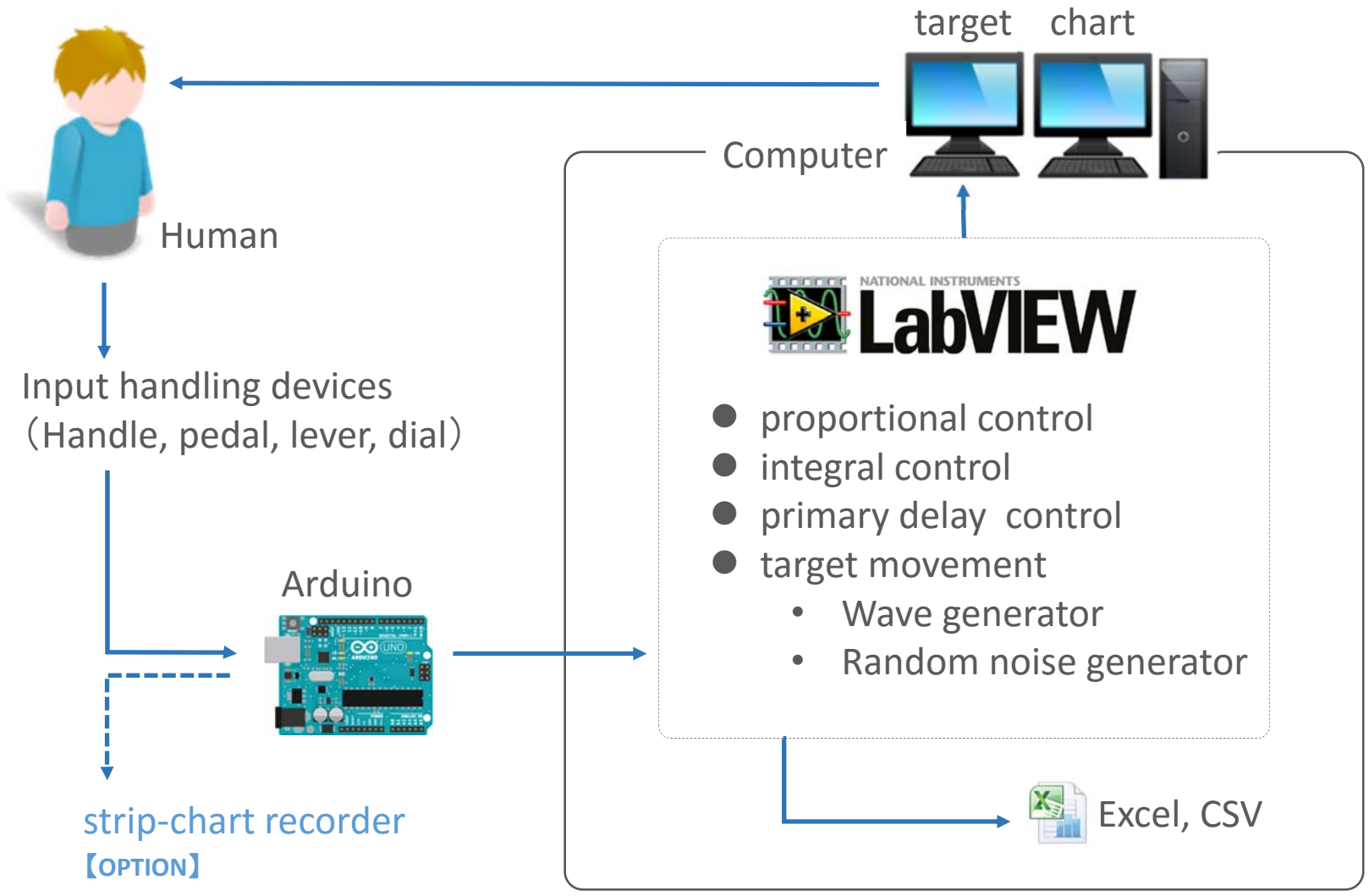
Computer LabVIEW

+

Arduino

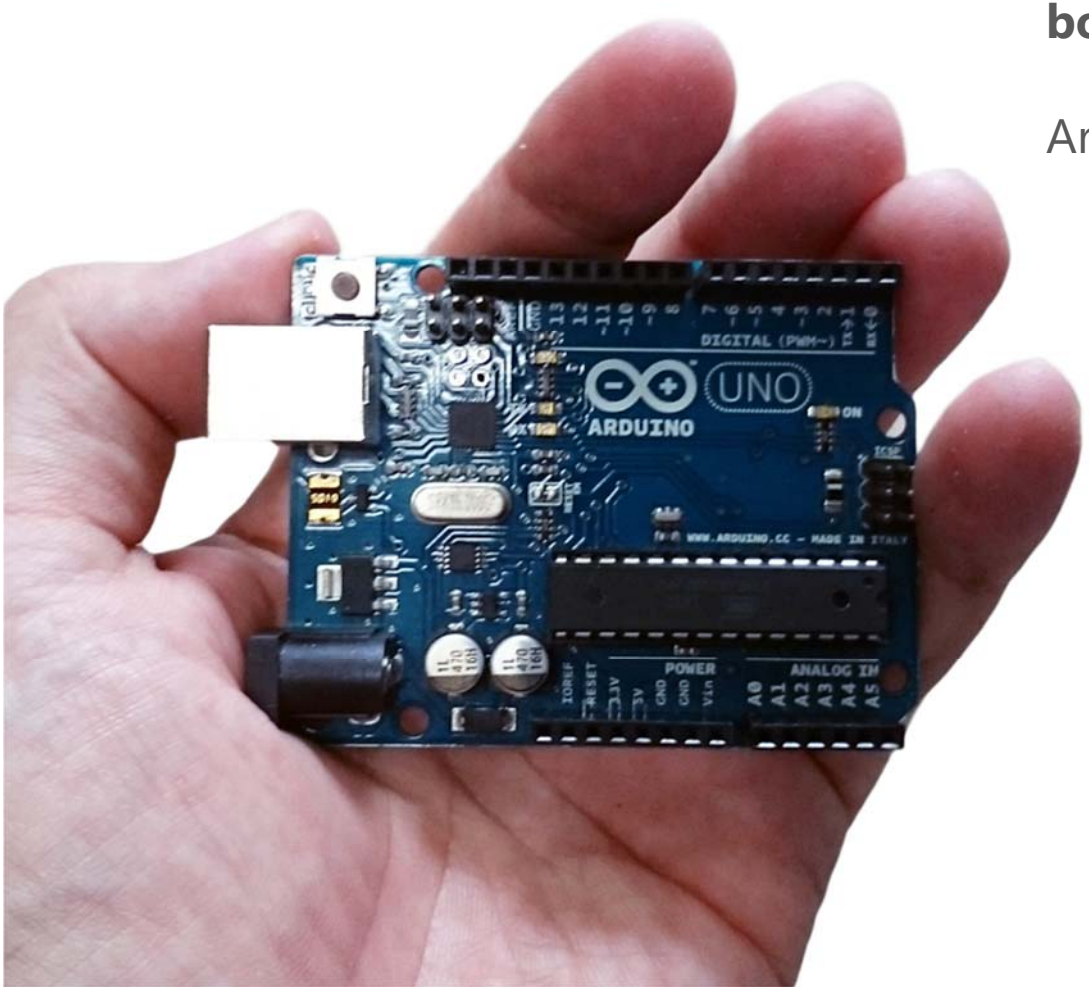
Digital simulation

New facility I planned



What is Arduino

What is Arduino



Arduino is a very popular and easy to use **microcontroller development board**.

Arduino is able to ...

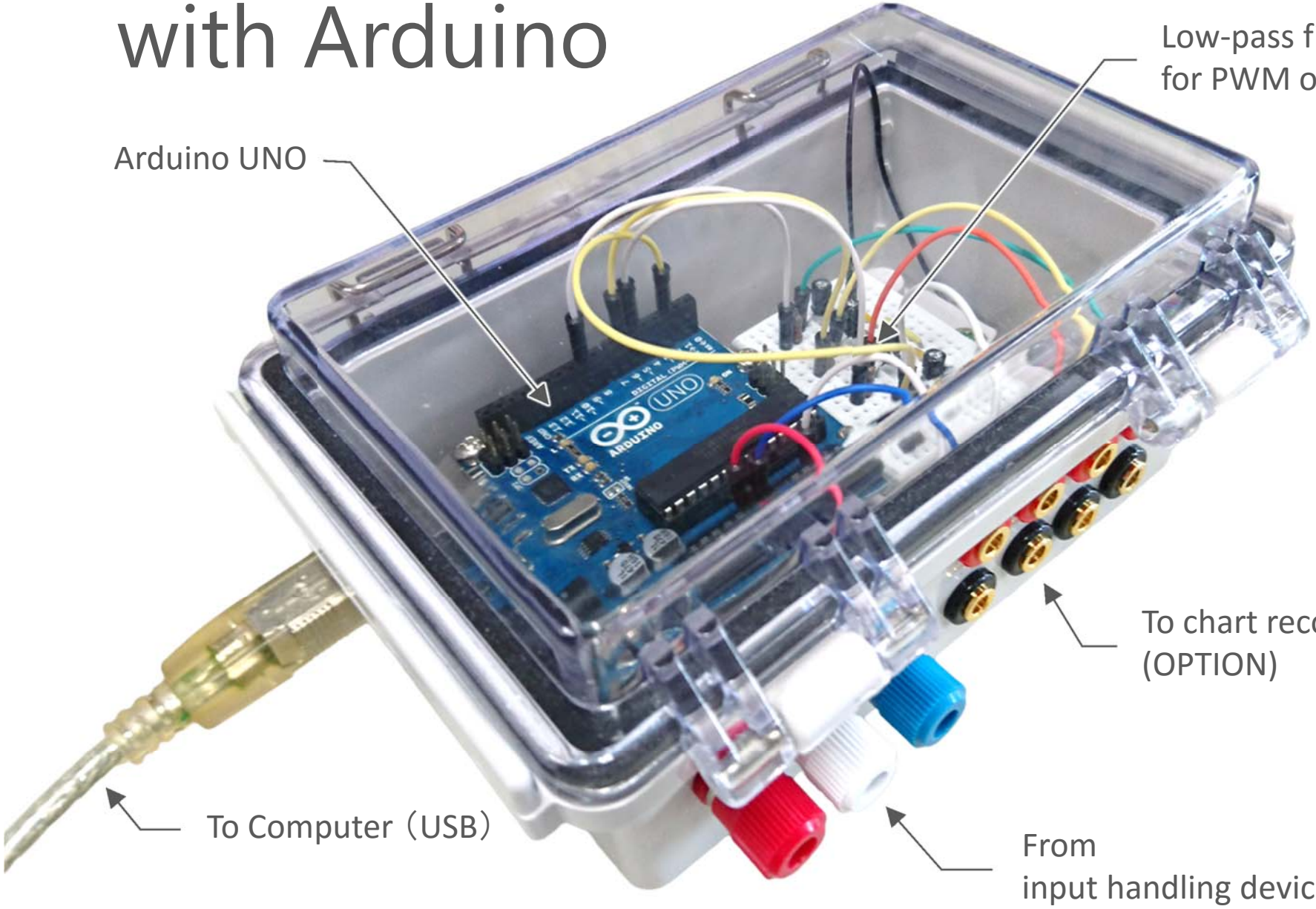
- light on a sensor
- a finger on a button
- a Twitter message

- activating a motor
- turning on an LED
- publishing something online

¥3,240 through amazon

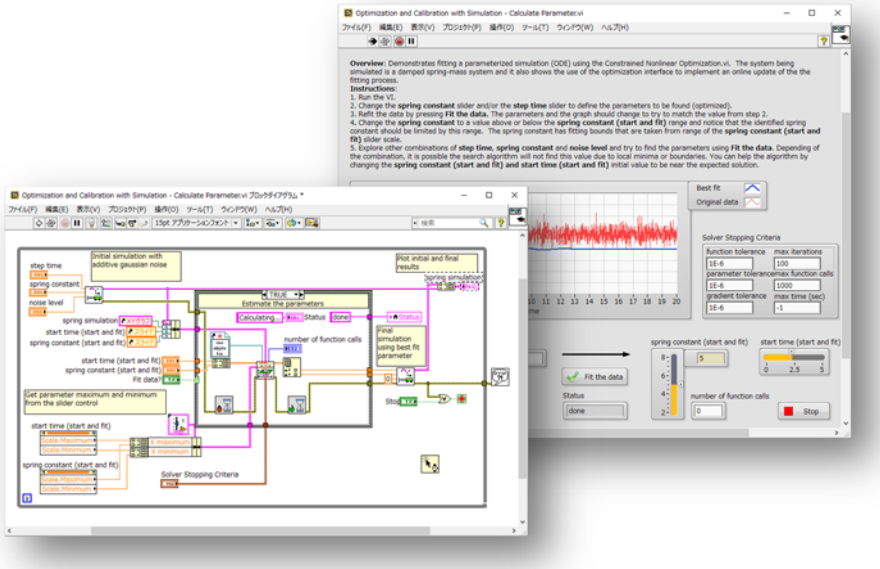
Note: Arduino UNO

A/D, D/A converter module with Arduino



What is LabVIEW

What is LabVIEW



LabVIEW is a **development environment software** for creating custom applications that **interact with real-world data or signals**

- **Graphical Programming**
- Hardware Support
- Analysis and Technical Code Libraries
- UI Components and Reporting Tools

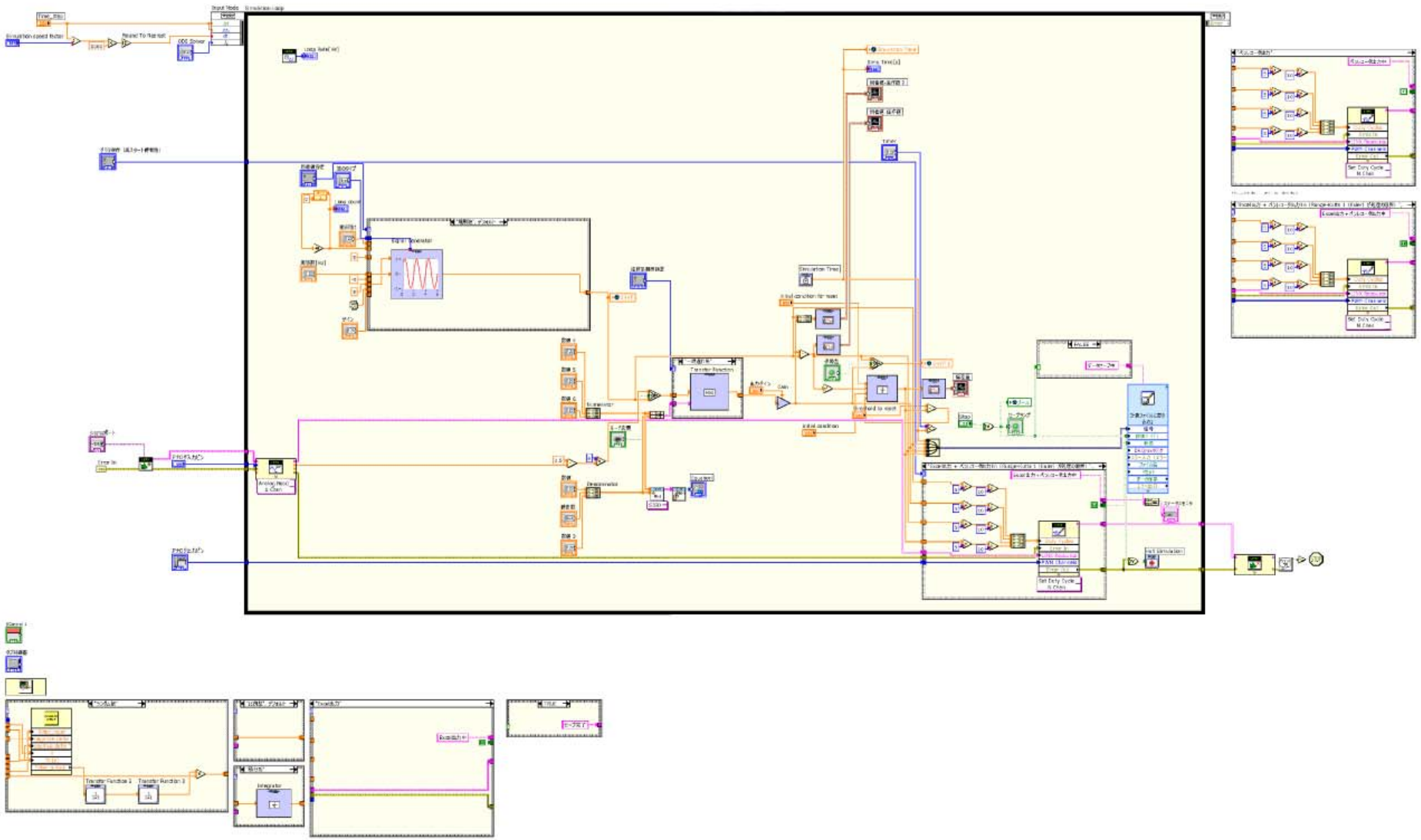
~~¥475,000~~ through NATIONAL INSTRUMENTS

Note: LabVIEW base system + Control and simulation module

↓

available for **Free** through ITC

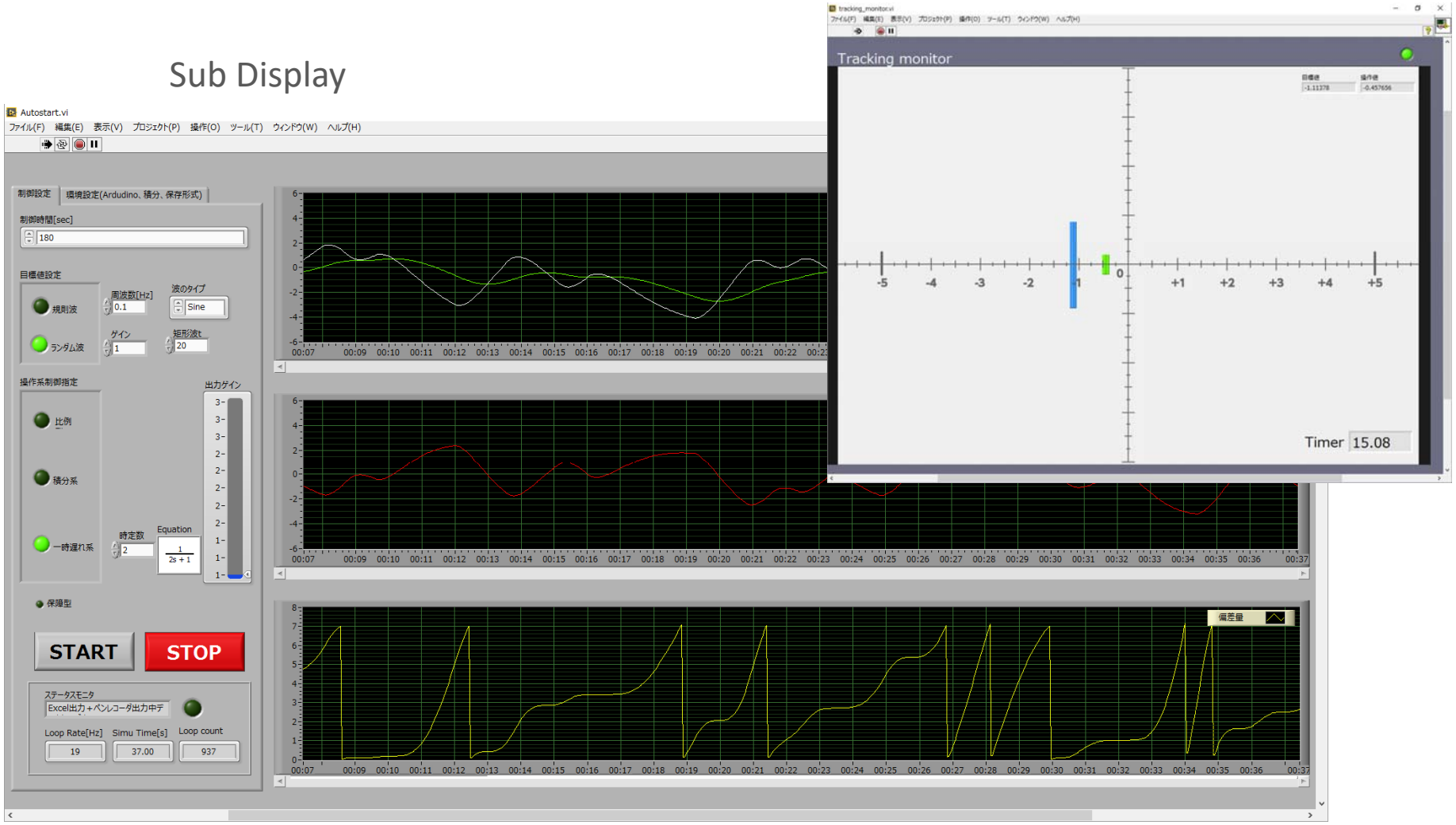
Source code for LabVIEW



Screen display for human

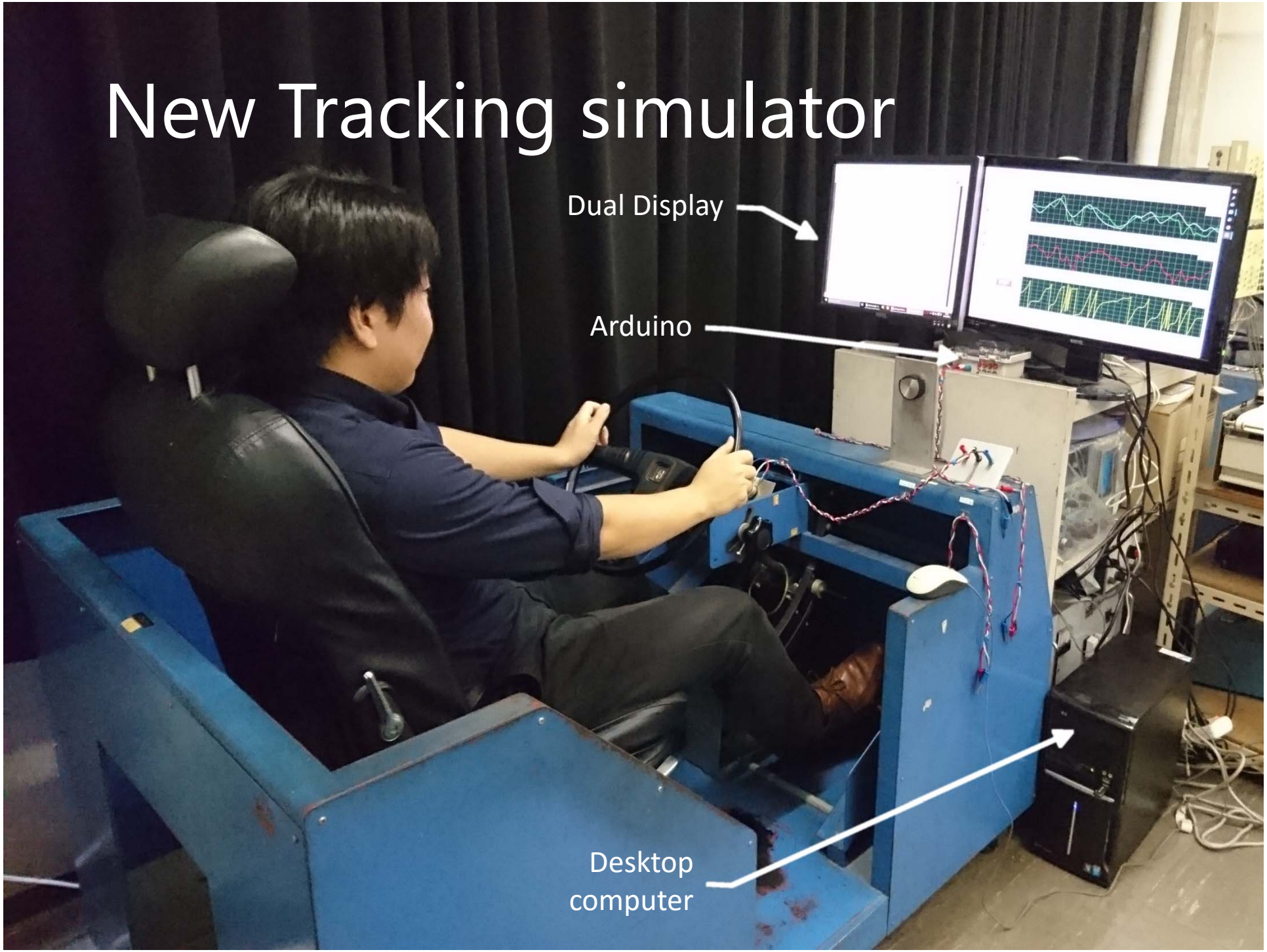
Main Display

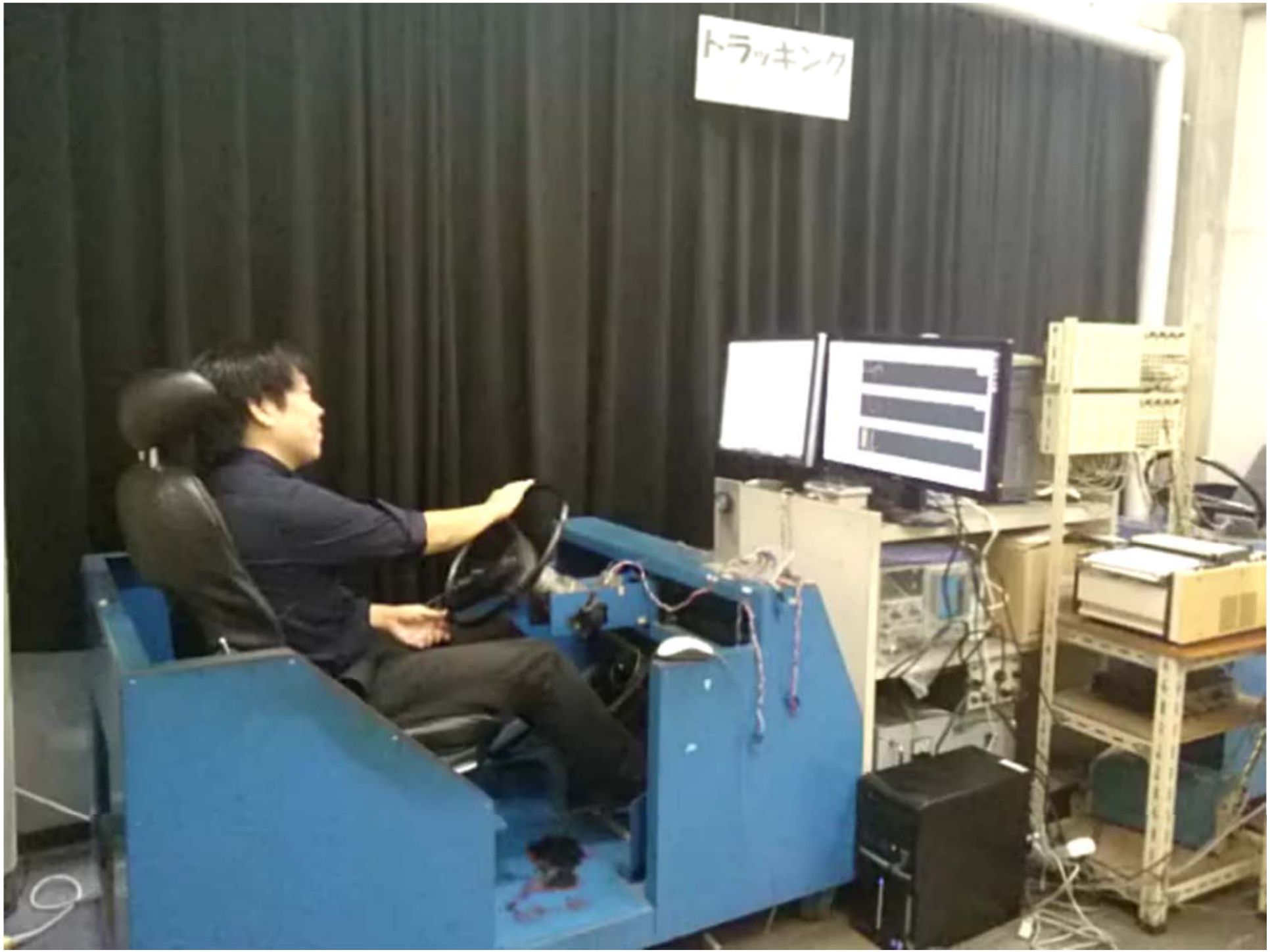
Sub Display



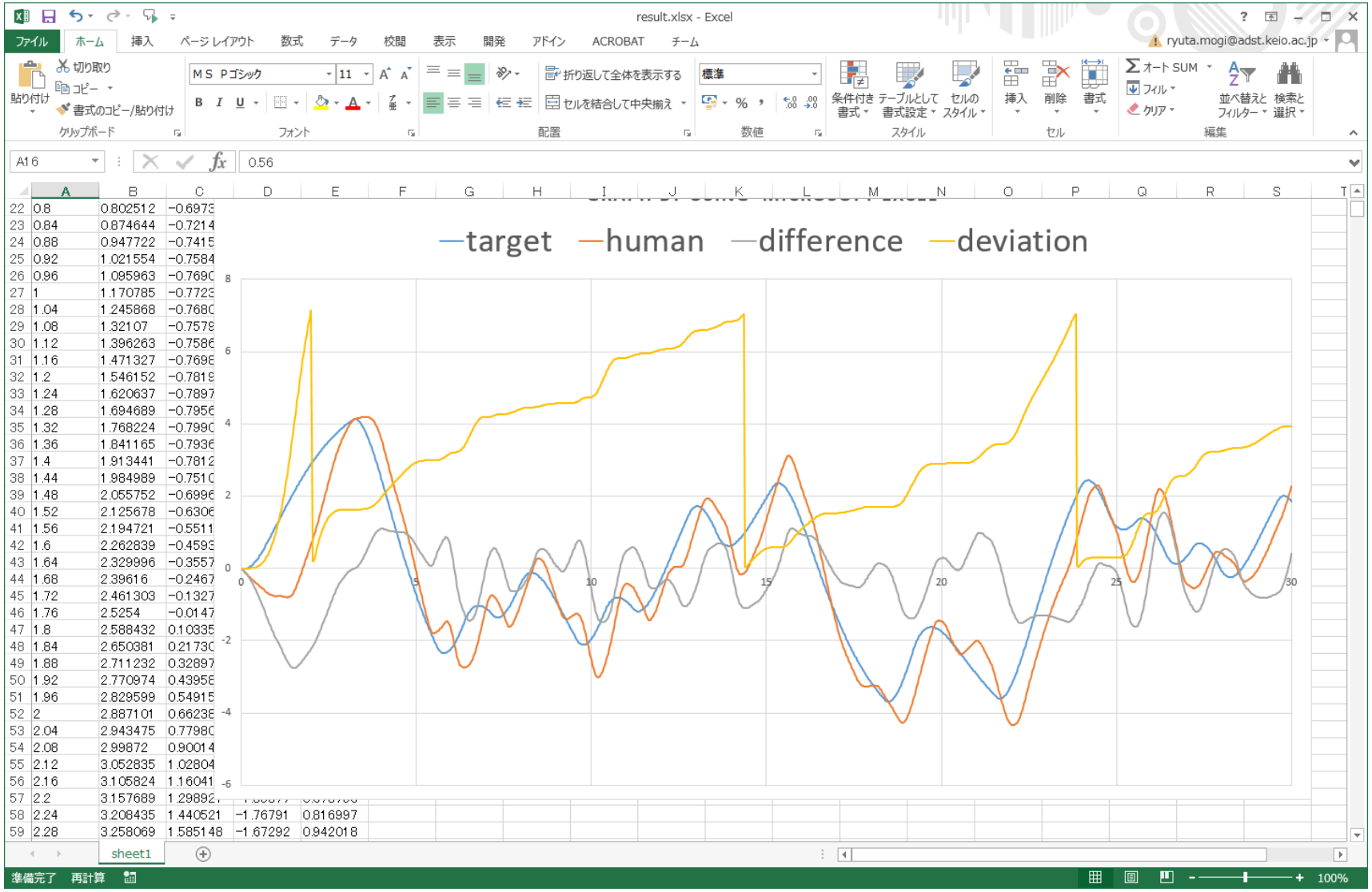
New tracking simulator

New Tracking simulator




トラッキング

Output graph on Excel



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Technical Issues

- This new tracking simulation requires a high specification desktop computer.

- Setting up the software environment is complicated and difficult for maintenance.

Comparison table

	Old facility	New facility
Hardware Maintenance	**Difficult**	—
Software Maintenance	—	**Difficult**
Cost	×	○
Usability	×	○
Extensibility	×	○

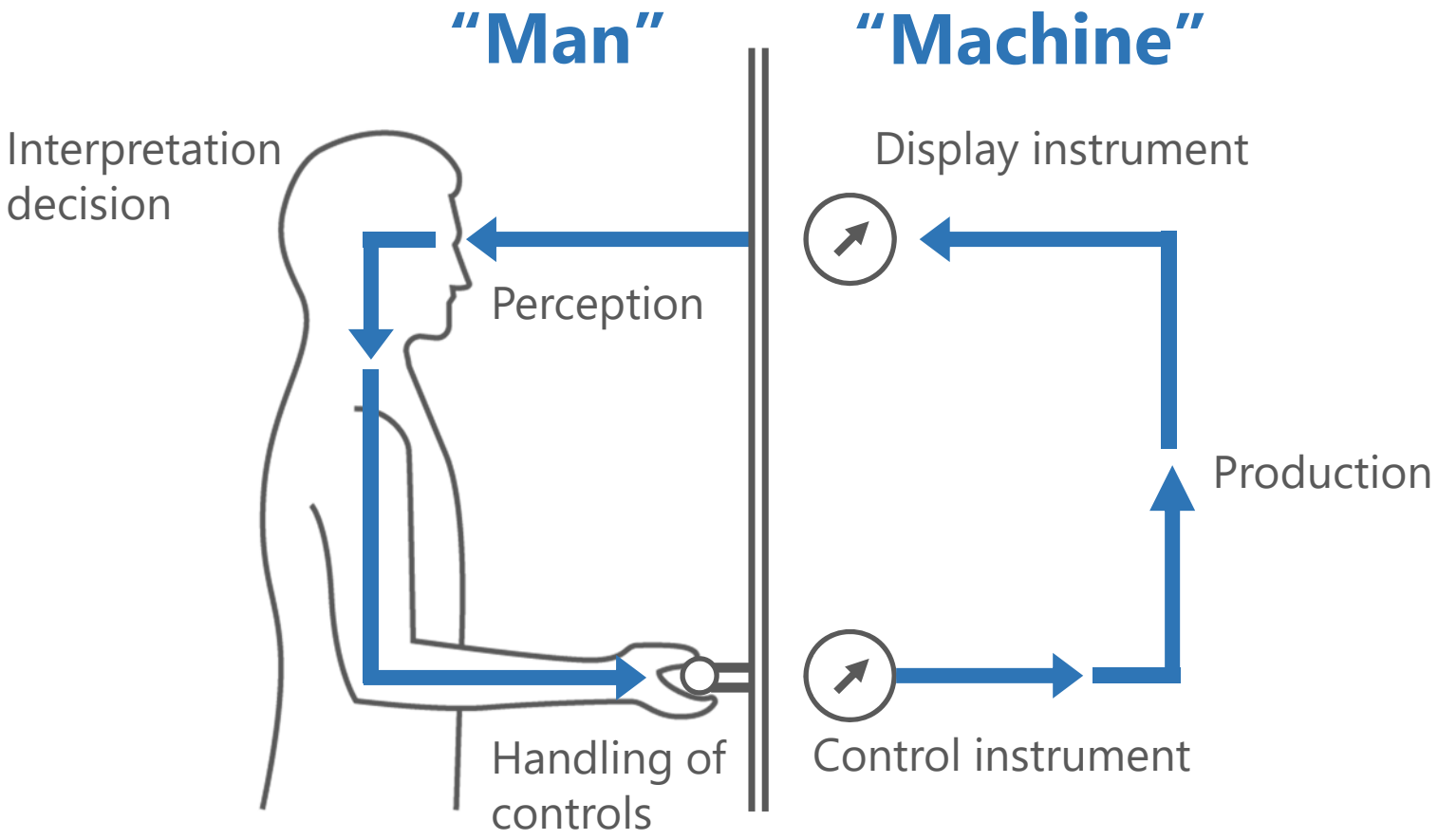
Summary and future plans

- I designed the new tracking simulator with LabVIEW and Arduino.
- This new facility is in the middle of tuning the details up and still a **prototype**.
- I expect new tracking simulator will be introduced **in the next school year**.

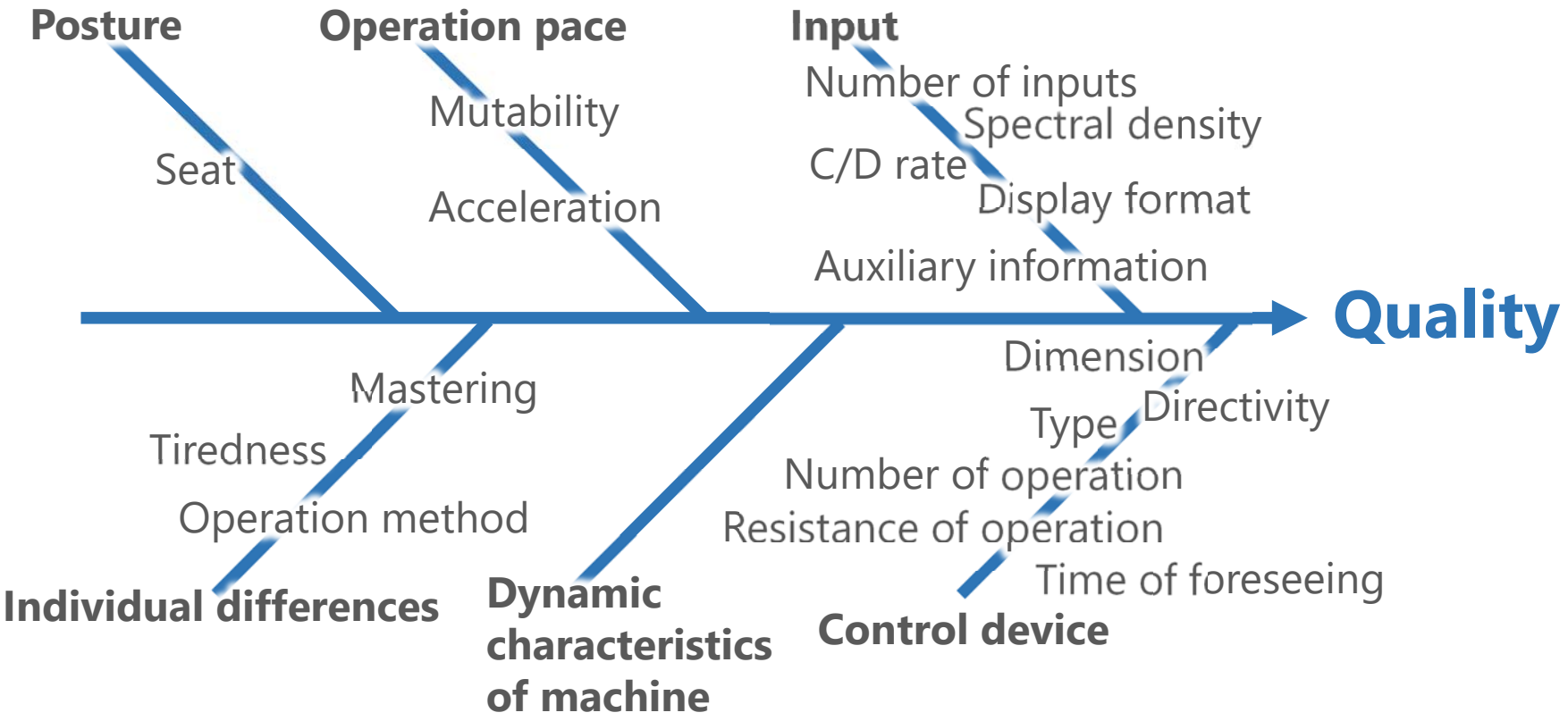
Thank you

Appendix

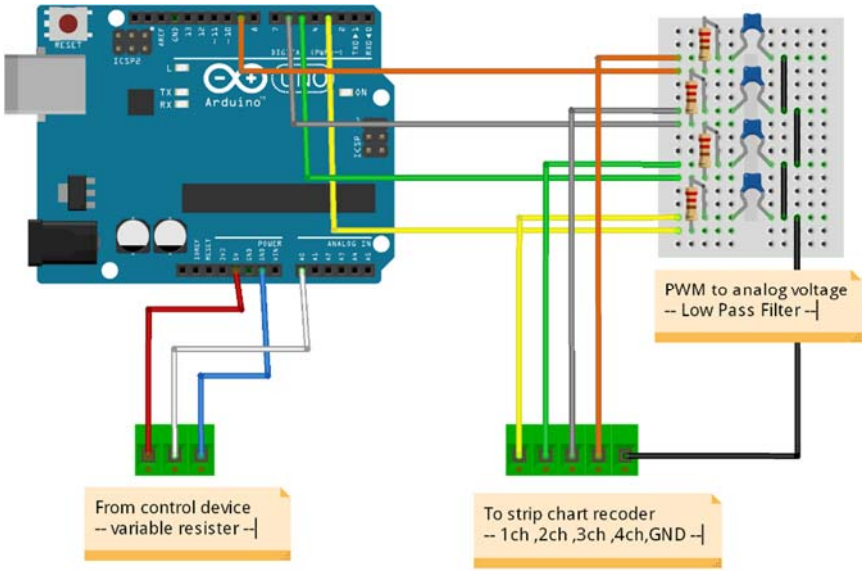
Man-Machine system

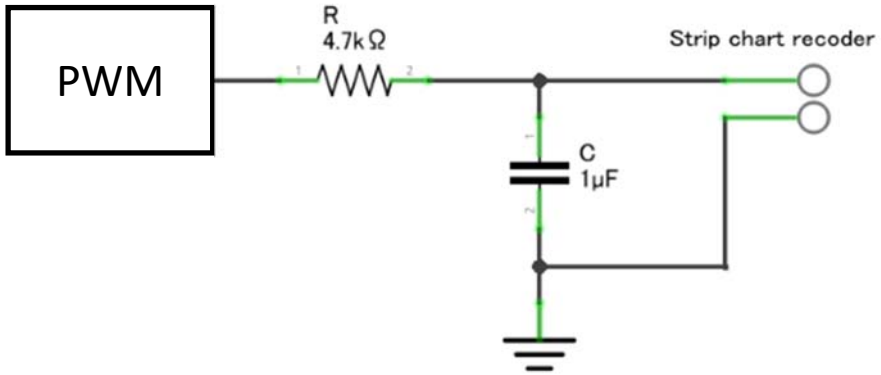


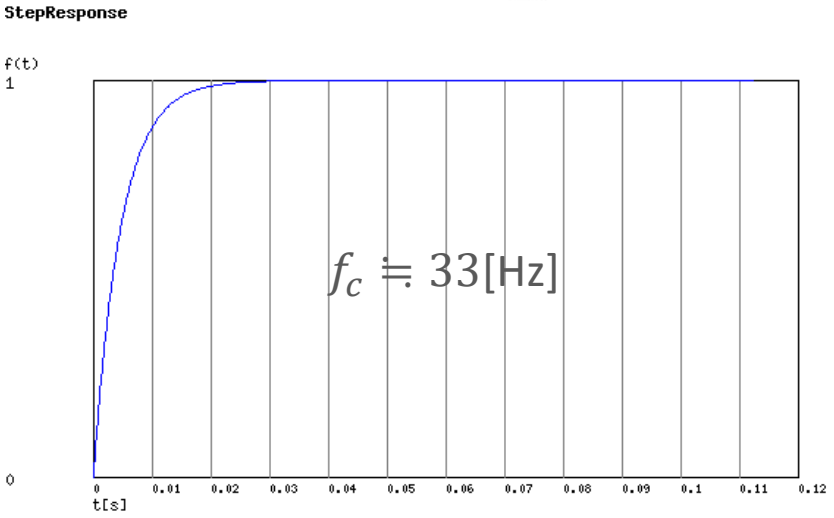
Factors influencing the quality of control



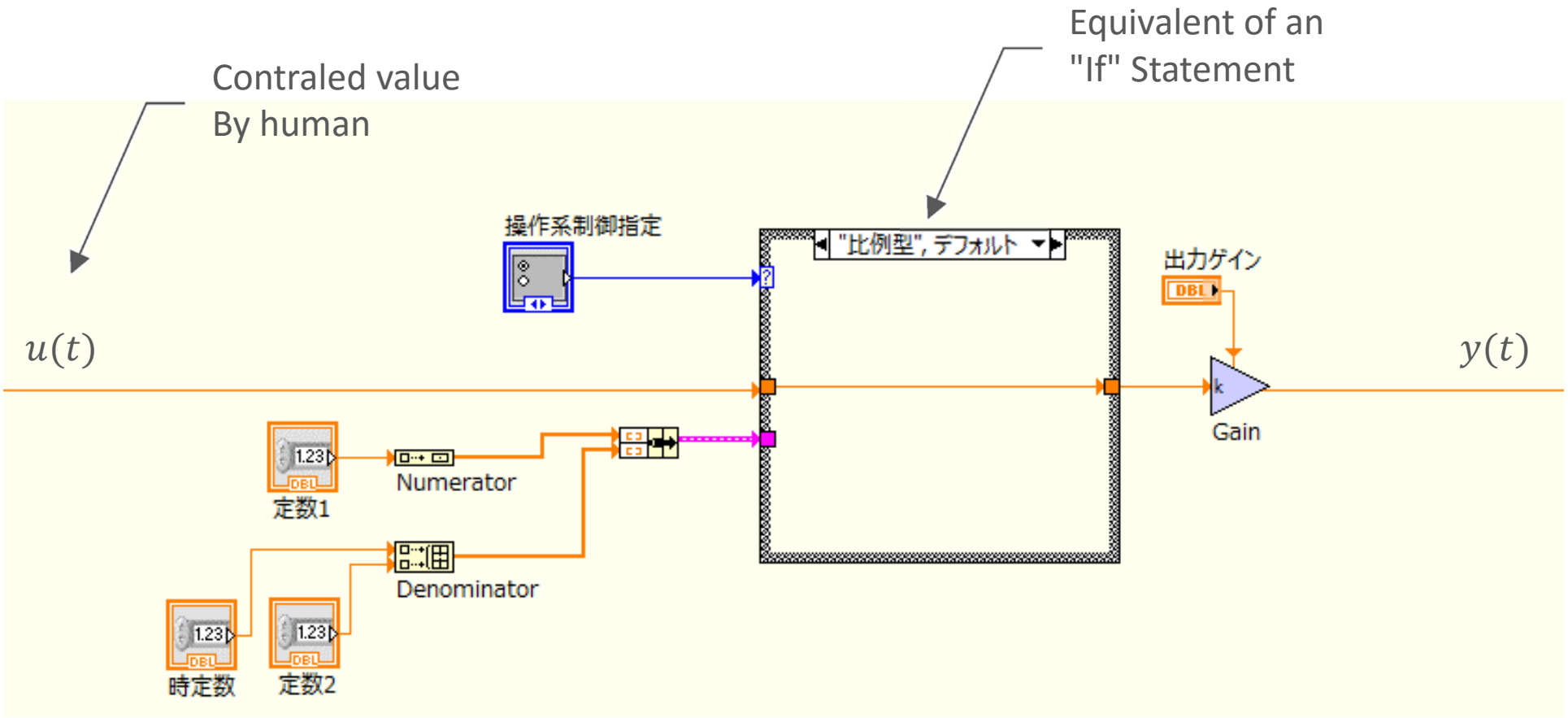
PWM to analog voltage for strip chart recorder





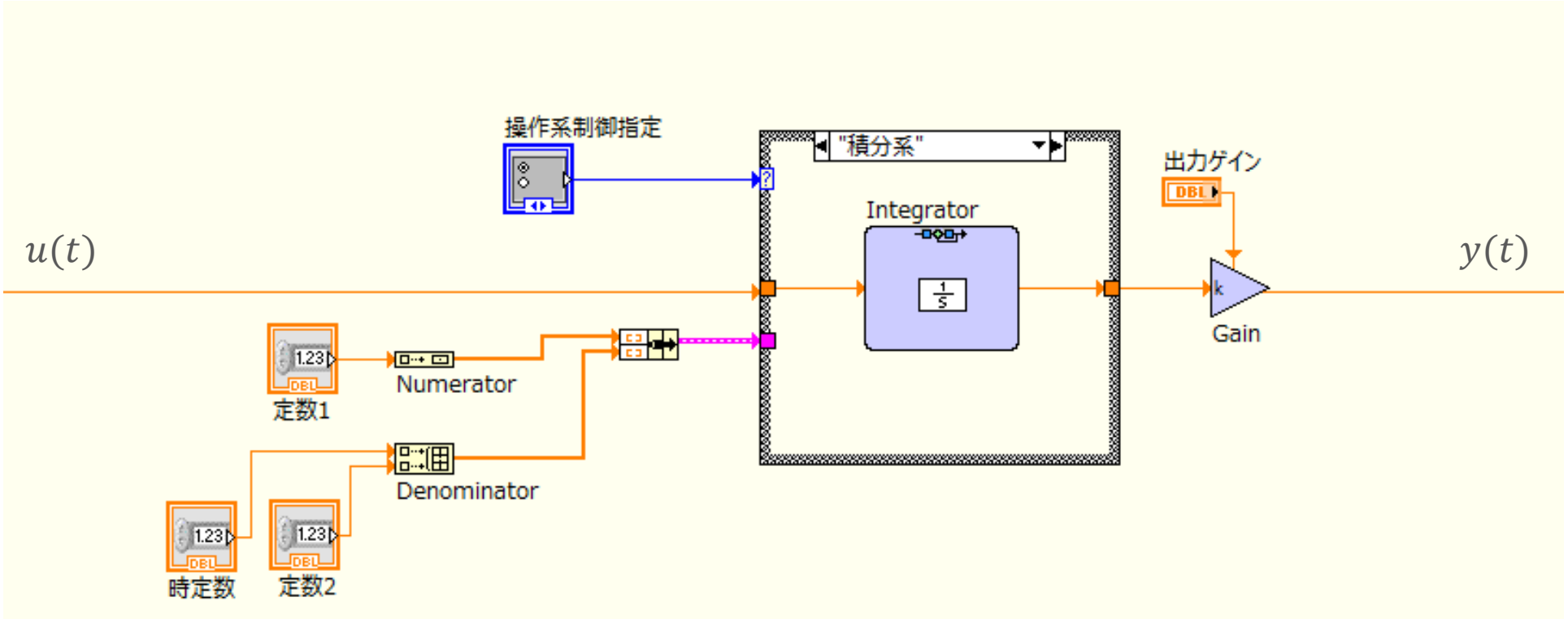


Part of propotion control



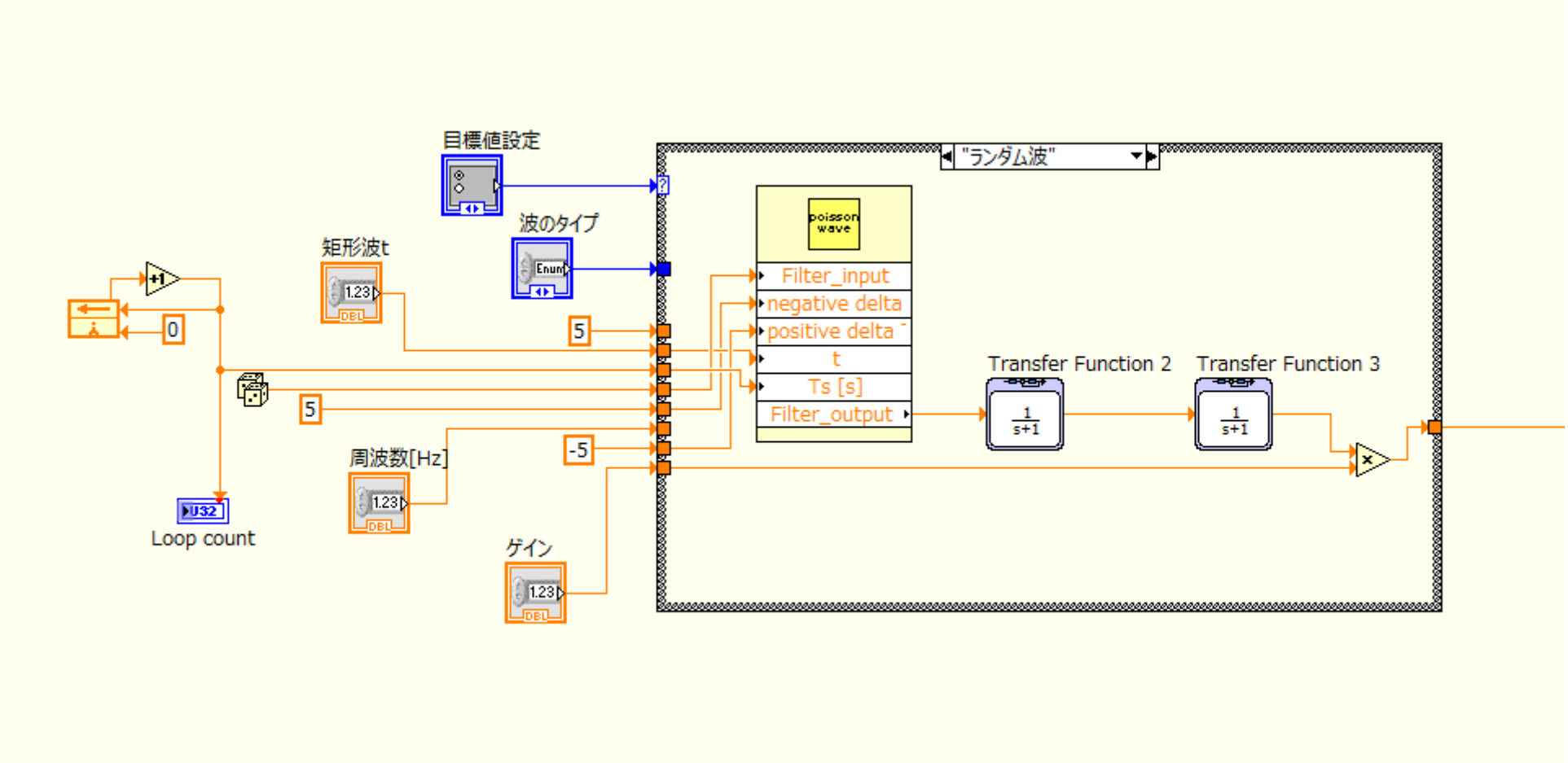
$$y(t) = ku(t), \quad G(s) = k$$

Part of integral controll

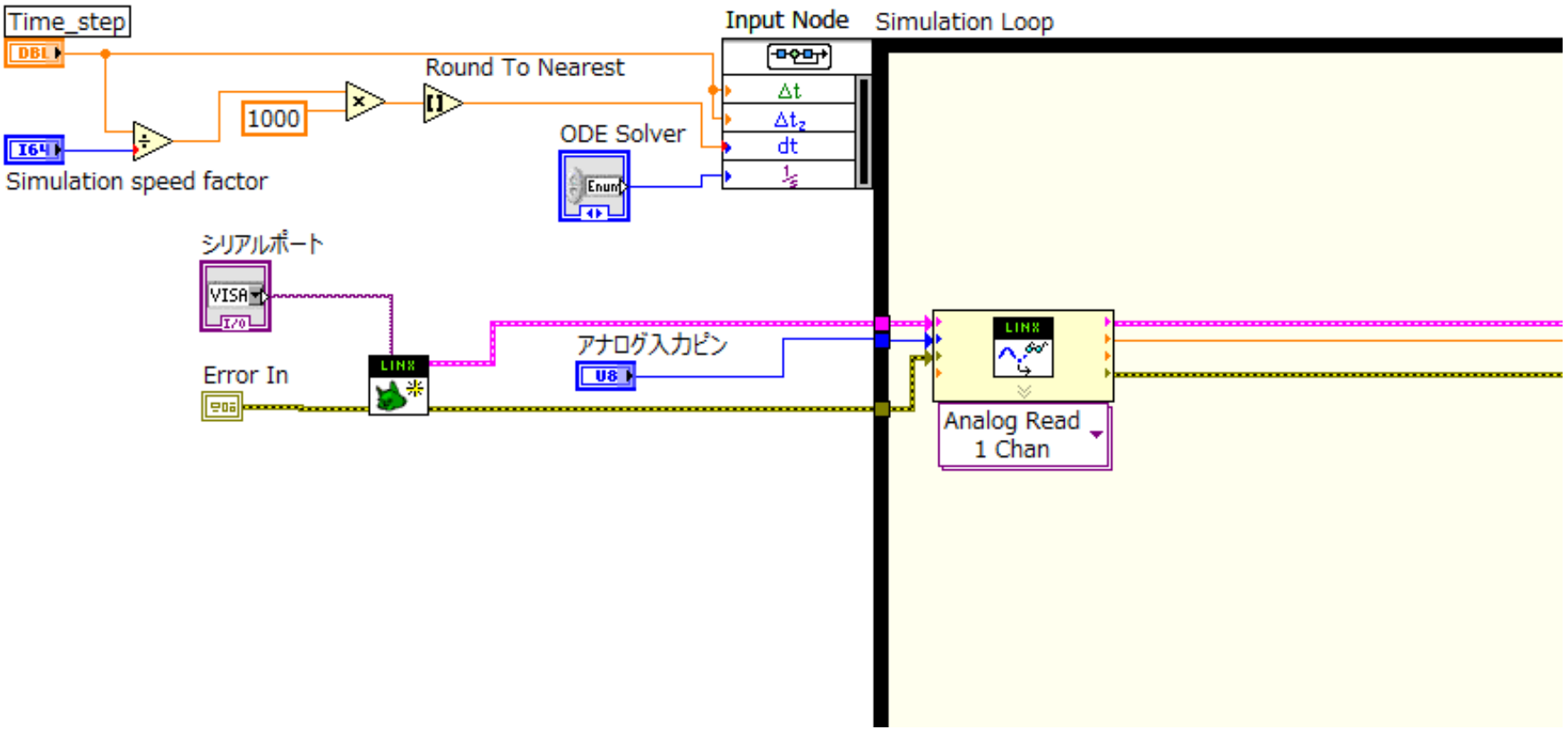


$$y(t) = k\int_0^t u(x)dx\,, \quad G(s) = \frac{k}{s}$$

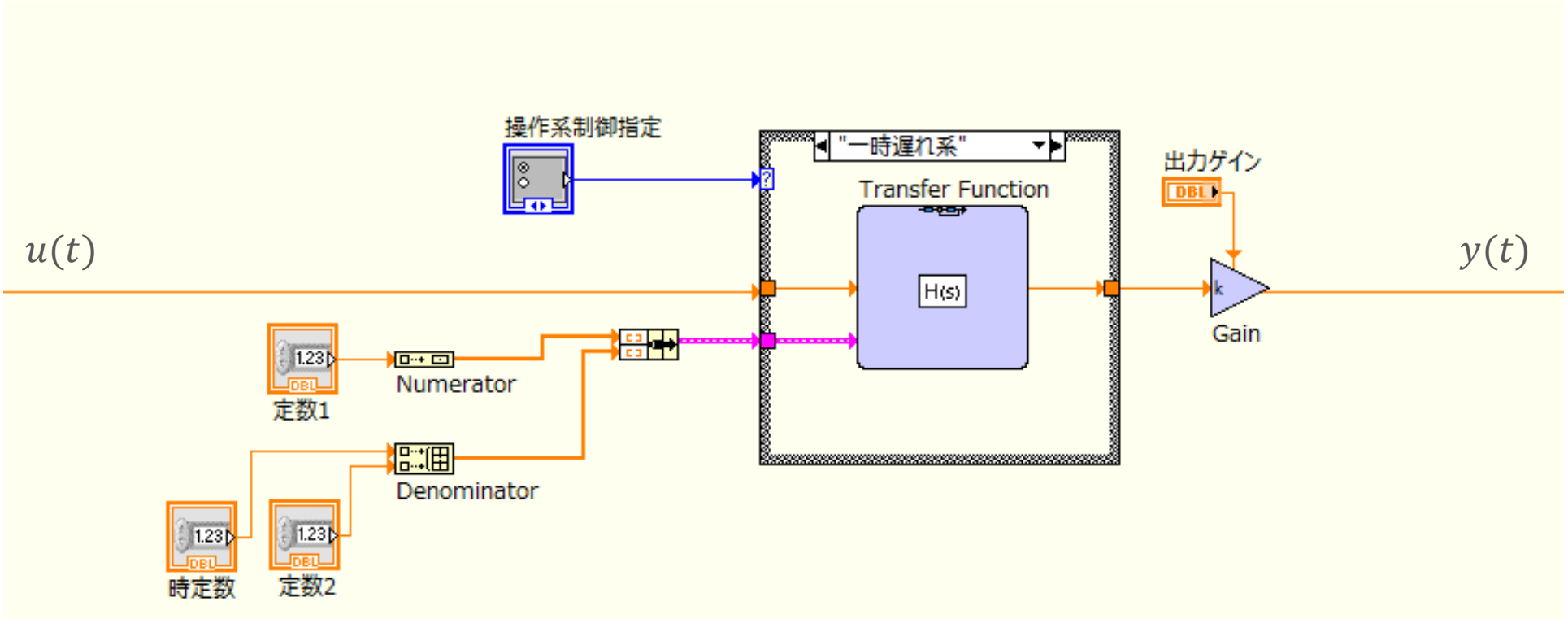
Part of random wave generator



Part of Arduino

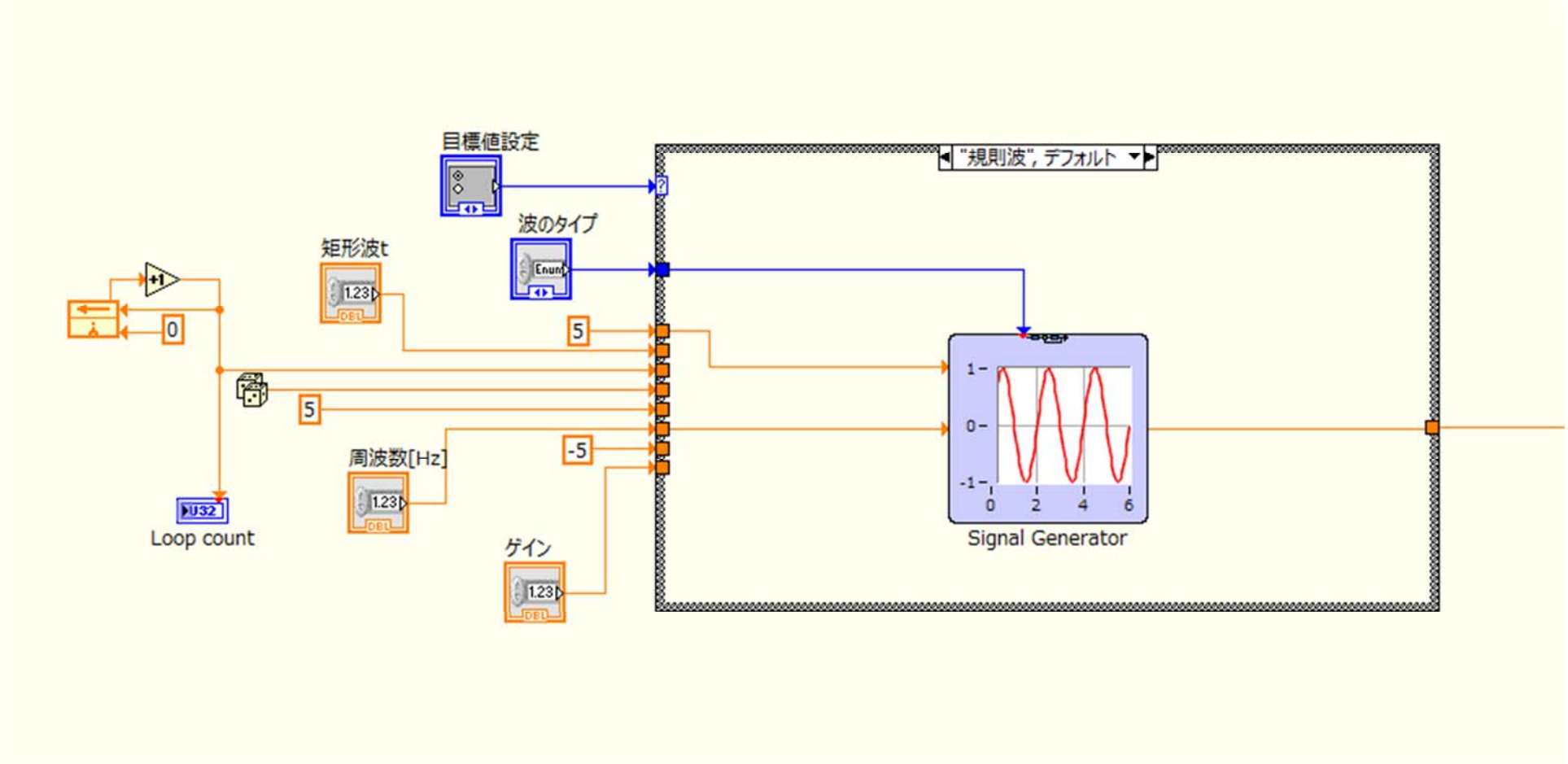


Part of primary delay control

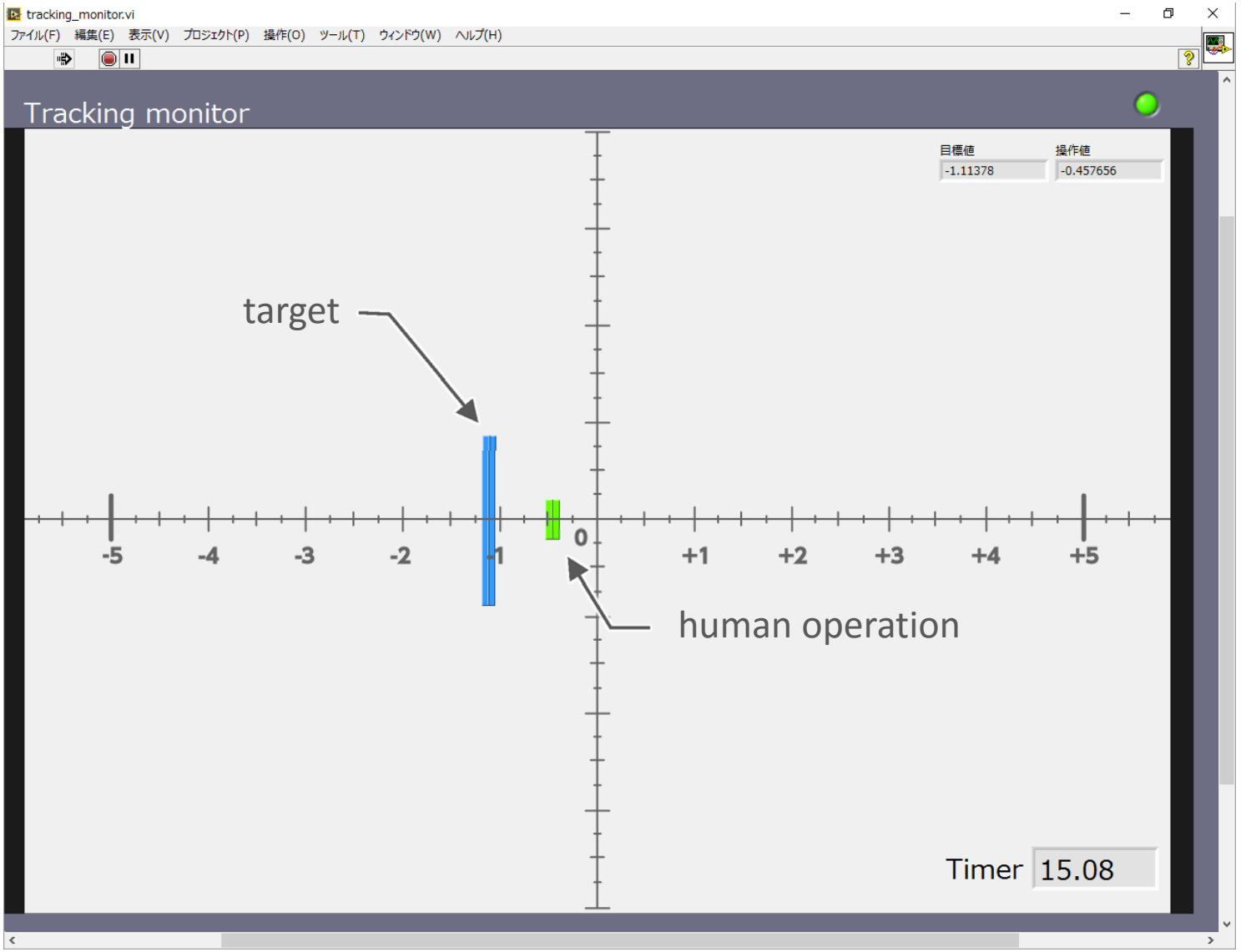


$$T\frac{dy(t)}{dt} + dy(t) = kau(t), \quad G(s) = \frac{ka}{Ts + b}$$

Part of wave generator except random wave



User interface overview



User interface overview