

Introduction to CPS Robot Blueprint Family

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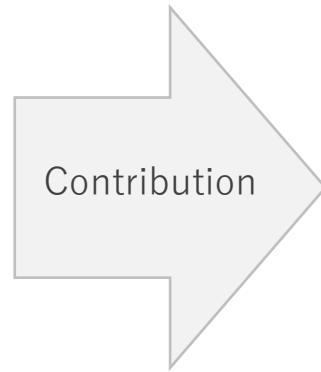


Agenda

- › Vision, Why robot?
- › Status of robot today
- › Challenges and solutions
- › What is SSES?
- › What is R-CPS?
- › Activities at Akraino
 - › CPS Robot blueprint family
 - › Robot basic architecture based on SSES blueprint

Vision

› Robotics can contribute to the achievement of SDGs



SUSTAINABLE DEVELOPMENT GOALS



【https://www.mofa.go.jp/policy/oda/sdgs/pdf/Japans_Effort_for_Achieving_the_SDGs.pdf】

Robots allow humans to focus on creative work

Status of robot today

› There are industries in which robots are not widespread



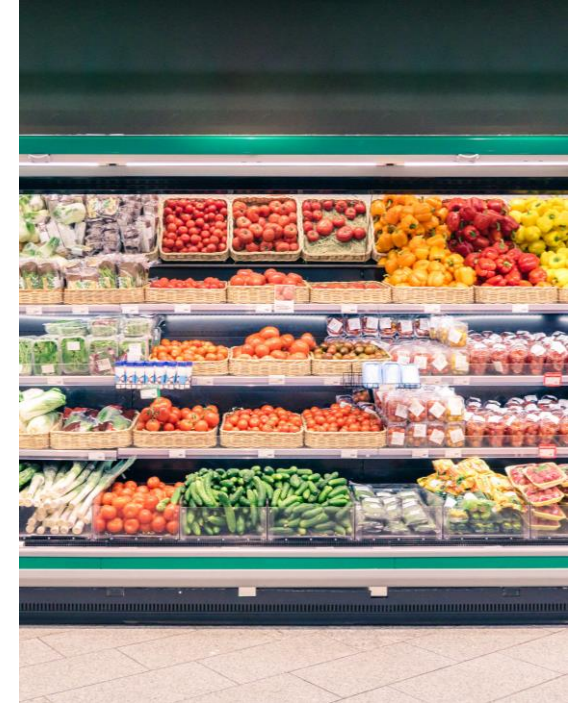
Agriculture



Restaurant



Food factory



Retail

“SIP SSES”

<https://sip-sSES.net/wp-content/uploads/2022/01/%E3%83%A2%E3%83%8E%E3%81%A5%E3%81%8F%E3%82%8A%E6%97%A5%E6%9C%AC%E4%BC%9A%E8%AD%B0%E5%8E%9F%E7%A8%BF.pdf>



Challenges

Robots today have challenges in these industries.

1. Objects with diverse shapes, flexibility, and frictional properties
2. Uncertain environment (uneven and wet ground, weather etc..)
3. High-mix small-lot production

Solution 1.

Flexible robot handling for various objects under various environments “SSES (Sensor-Rich Soft End-Effector System)”

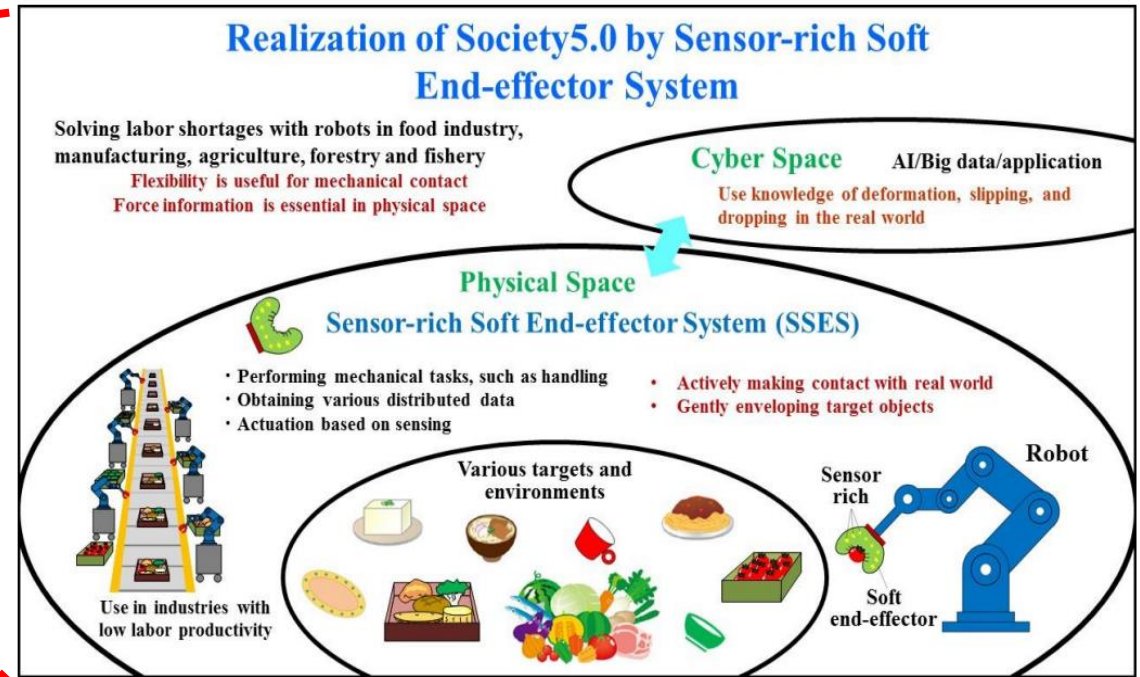
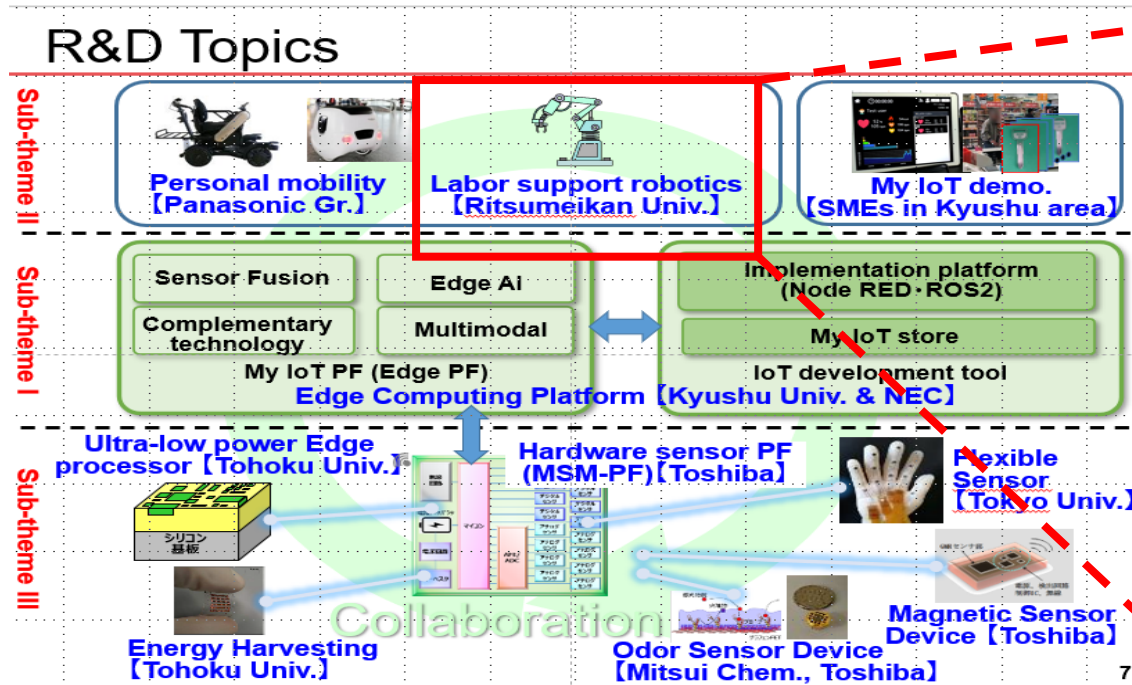
4. Rapid communication with robots for human and robot co-working

Solution2. Reliable and low-latency speech recognition
(Jeff, Signalogic will talk in the next presentation.)

SSES (Sensor-rich Soft End-effector System)

Japan's Cabinet Office invests in R&D on flexible robot handling "SSES" through SIP.

(Cross-ministerial Strategic Innovation Promotion Program)



SIP Symposium 2021

https://www.sip2021.go.jp/docs/02_briefing_paper_SIP2021.pdf



SIP R&D Plan

<https://www.nedo.go.jp/content/100903325.pdf>

SSES (Sensor-Rich Soft End-Effector System)

Ritsumeikan University and other companies research and develop SSES in SIP.

*SIP: Cross-Ministerial Strategic Innovation Promotion Program

› SSES Approach

› Enhancement of cognitive ability

- › Sensor-rich technology for multi-dimensional data acquisition
- › AI/IoT technology with force/contact information
- › IoT maintenance and inspection technology

› New Mechanical

- › Flexible manipulators using polymer materials
- › Advanced 3D printing technology

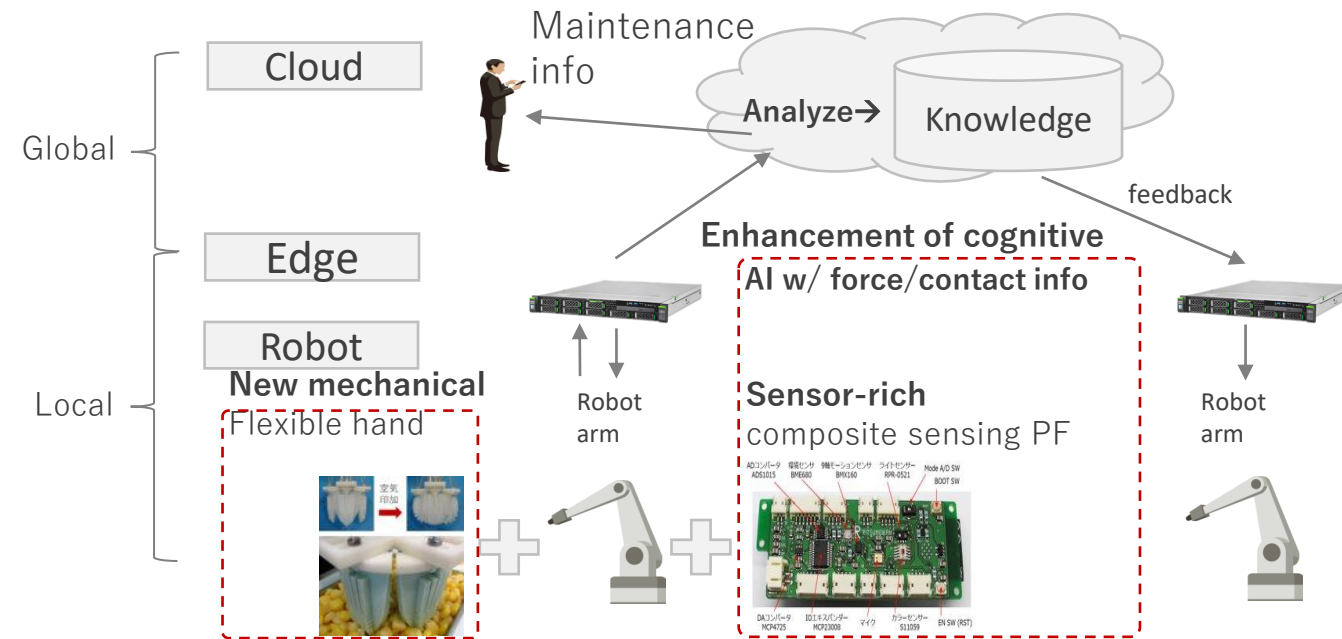


Figure: SSES architecture(<https://sip-sSES.net/>)

SSES use case and demo



Remove dishes from table



Dishwashing

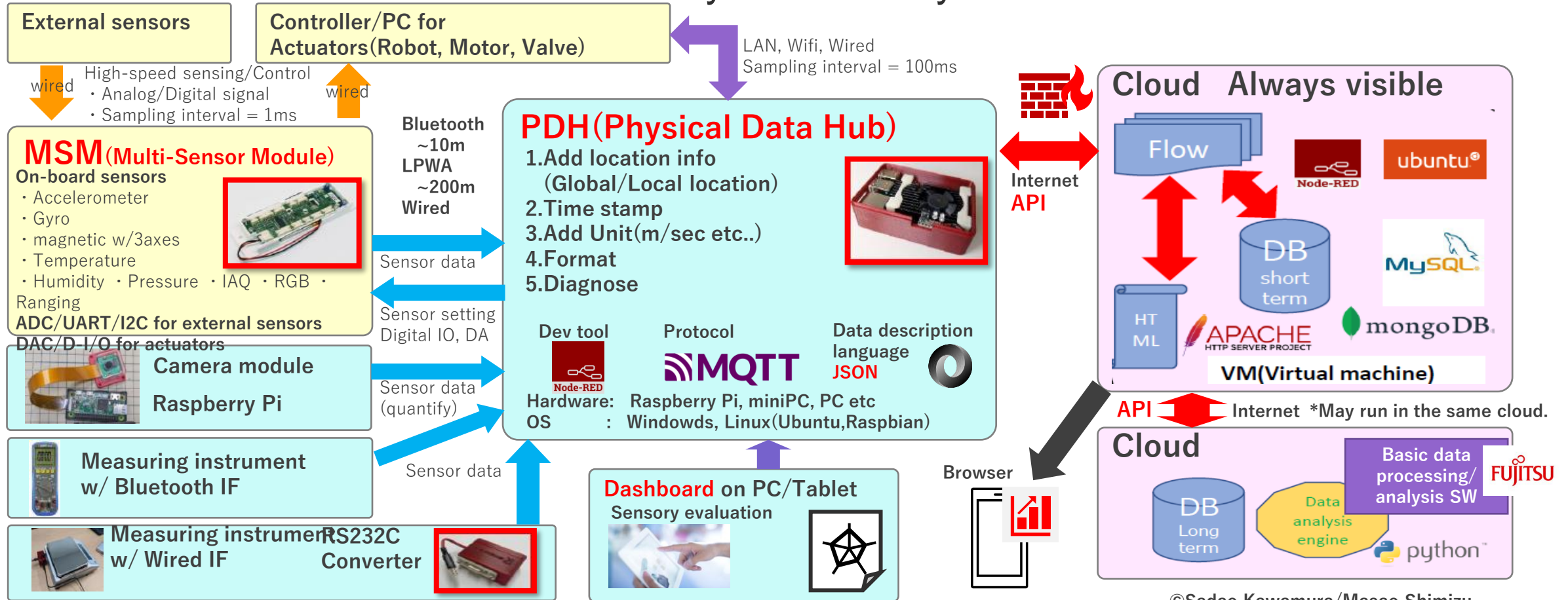


Serve on plate

All video from
SIP SSES project
<https://sip-sses.net/publicinformation/>

R-CPS(Reconstructable basic system for Cyber Physical System)

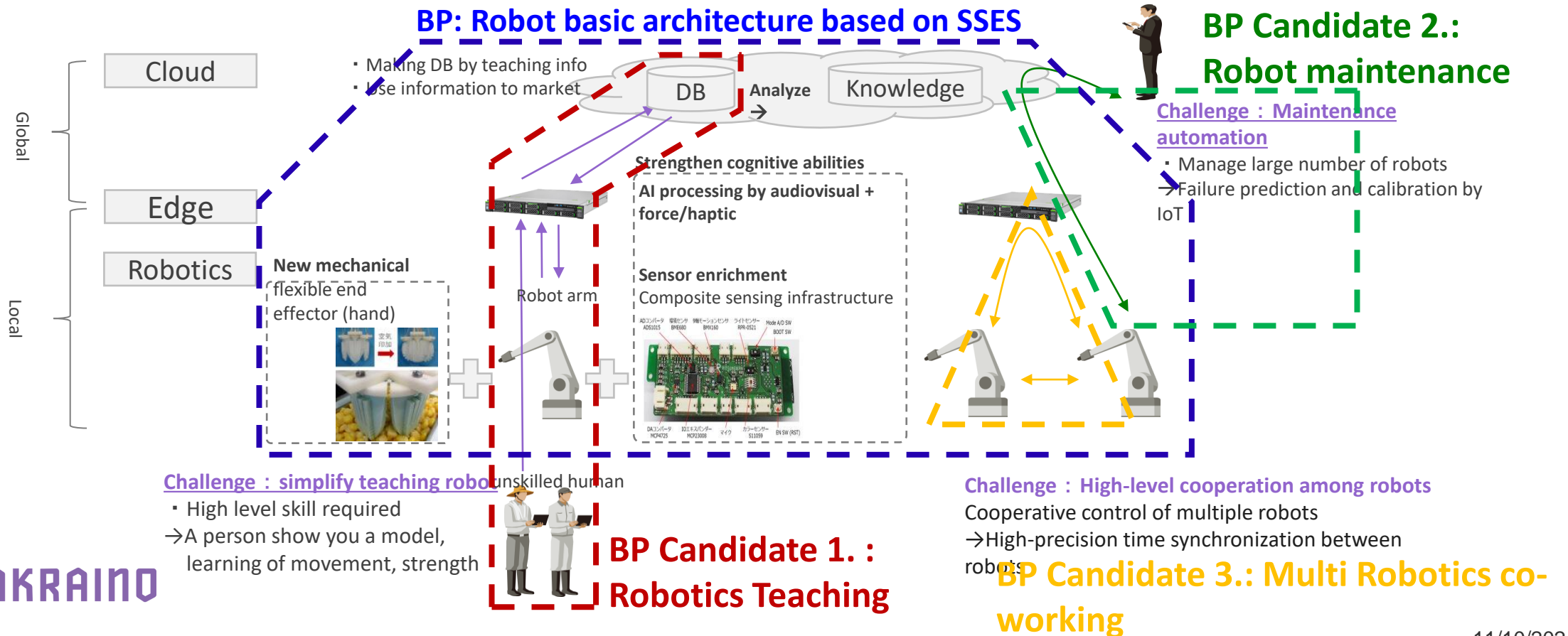
- Data collection/analysis and feedback to physical space for SSES
- Construct and reconstruct various systems easily and at low cost.



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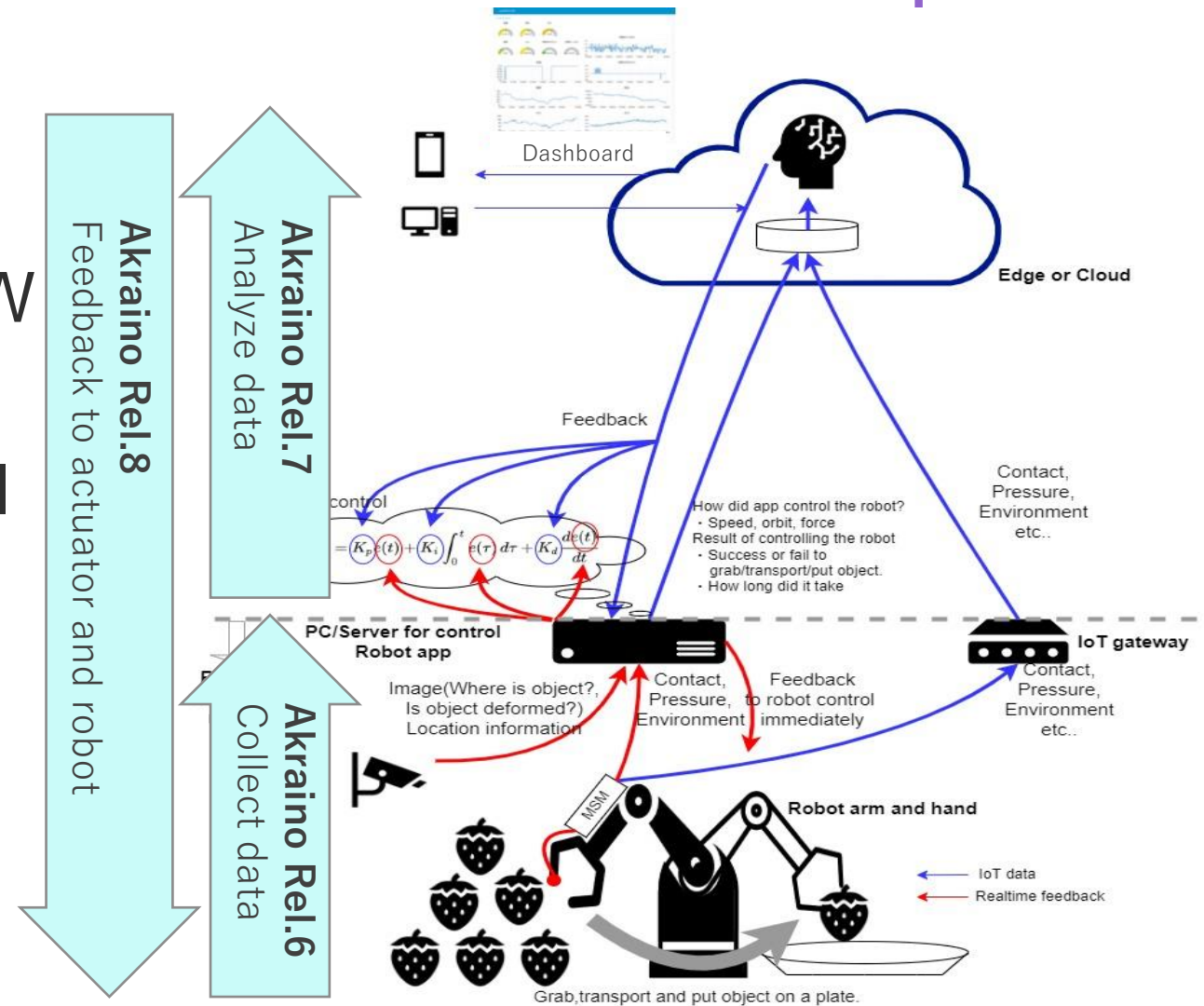
CPS Robot Blueprint family overview

- There are many challenges and use cases, and solutions will be a combination of elemental tech.
- We launched CPS Robot Blueprint family on Akraino.
- Focusing on "Robot basic architecture Blueprint" to provide OSS stack based on SSES/R-CPS.

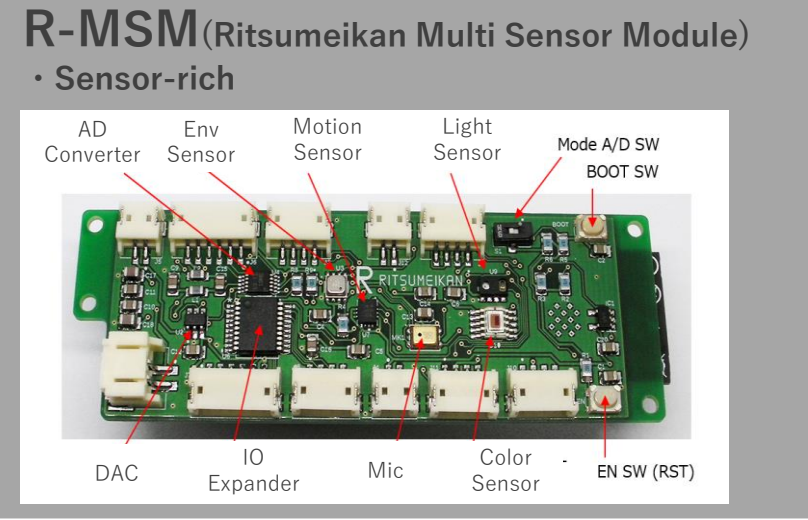
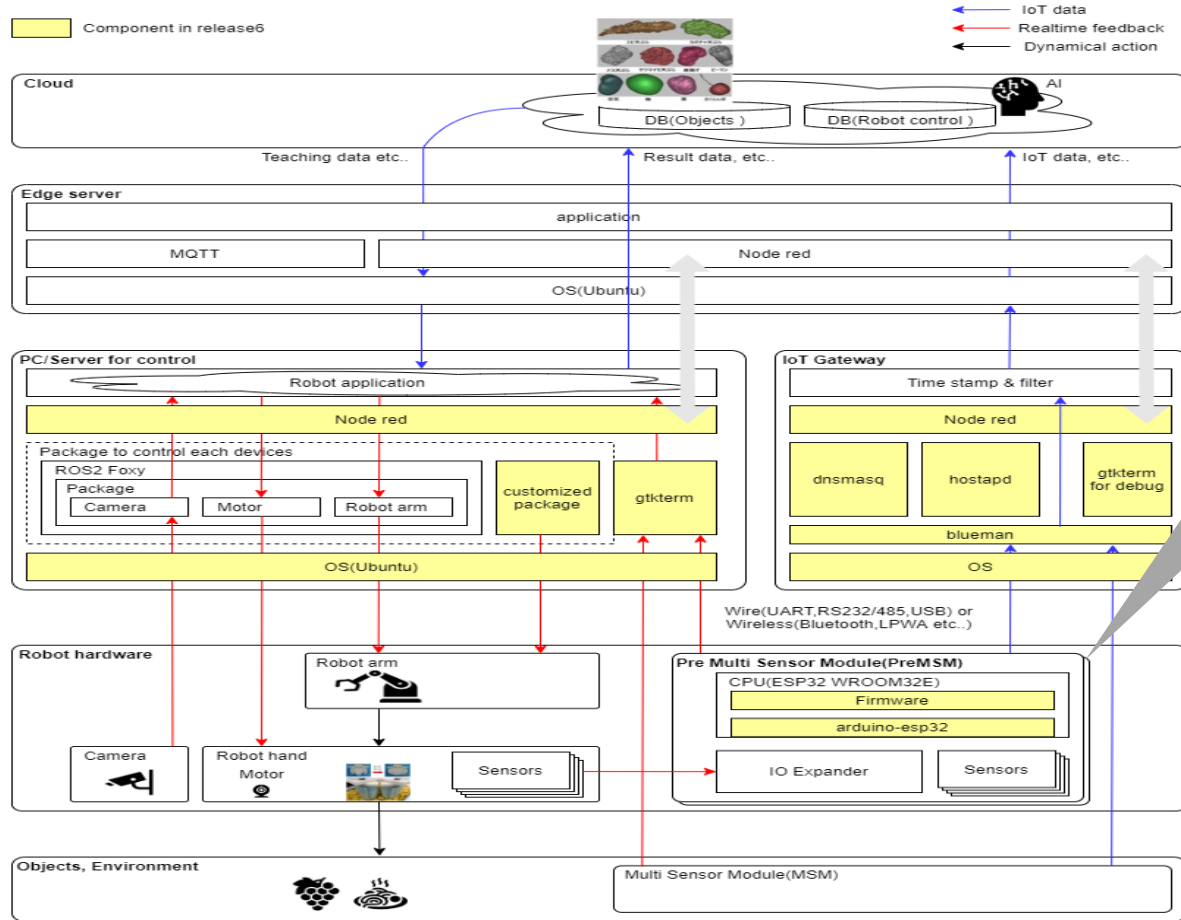


Robot basic architecture based on SSES Blueprint

- › Open software stack for
 - › Collect sensor/robot data using R-MSM and IoT GW
 - › Analyze data
 - › Feedback to robot control



Detail of blueprint in Akraino R6



- › Documents are available on wiki [Robot basic architecture based on SSES - Akraino - Akraino Confluence](#)
- › Architecture document
- › Installation/Test document

You can easily build data collection function.



Detail of blueprint in Akraino R7

› Enhance functionality

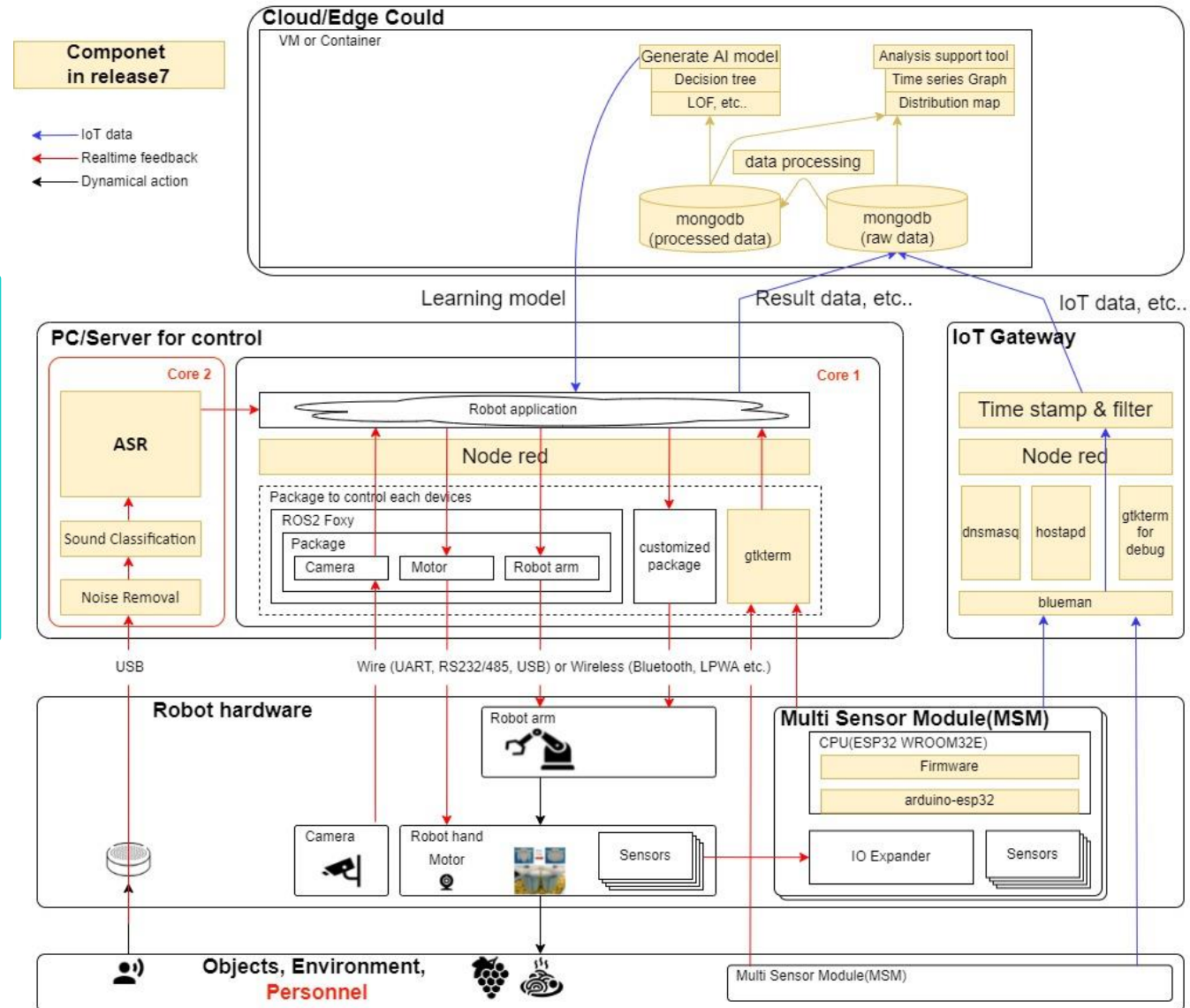
- › Data processing
- › Data analysis

Release basic data processing and analysis software libraries to support a variety of use cases.

› ASR

(Automatic speech recognition)

Jeff, Signalogic will talk in the next presentation.



Basic data processing and analysis software

Data processing and analysis methods differ depending on use case. This library provides common method and accelerates implementation of data processing and analysis.



Classification	function	Summary
Data processing	read_db_env	Returns the environment data for the specified time period.
	detect_change	Detect the point of change in data for a specified time period.
	resample	Resampling Input time series data.
	calc_maxminavg	Calculate the maximum, minimum, and average values for a specified time period.
Data analysis	kmeans	Classify time series data by k-means method.
	plt_ouerrap_fig	Create a chart that overlays multiple time series data.
others	diagnose	Graph the reception period of R-MSM data and detect reception errors.



Robot Blueprint activities in future

- › Enhance current blueprint functionality
 - › Autonomous optimization of Robot Control
 - e.g Parameter optimization of PID control
 1. Store data measured by robot control PC and R-MSM (Robot control result, contact, pressure etc..)
 2. Analyze data in the cloud for better parameters
 3. **Feedback parameters to robot control**

Welcome participants

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This work was supported by the Cabinet Office (CAO) and the Cross-ministerial Strategic Innovation Promotion Program (SIP), “An intelligent knowledge processing infrastructure, integrating physical and virtual domains” (funding agency: NEDO).

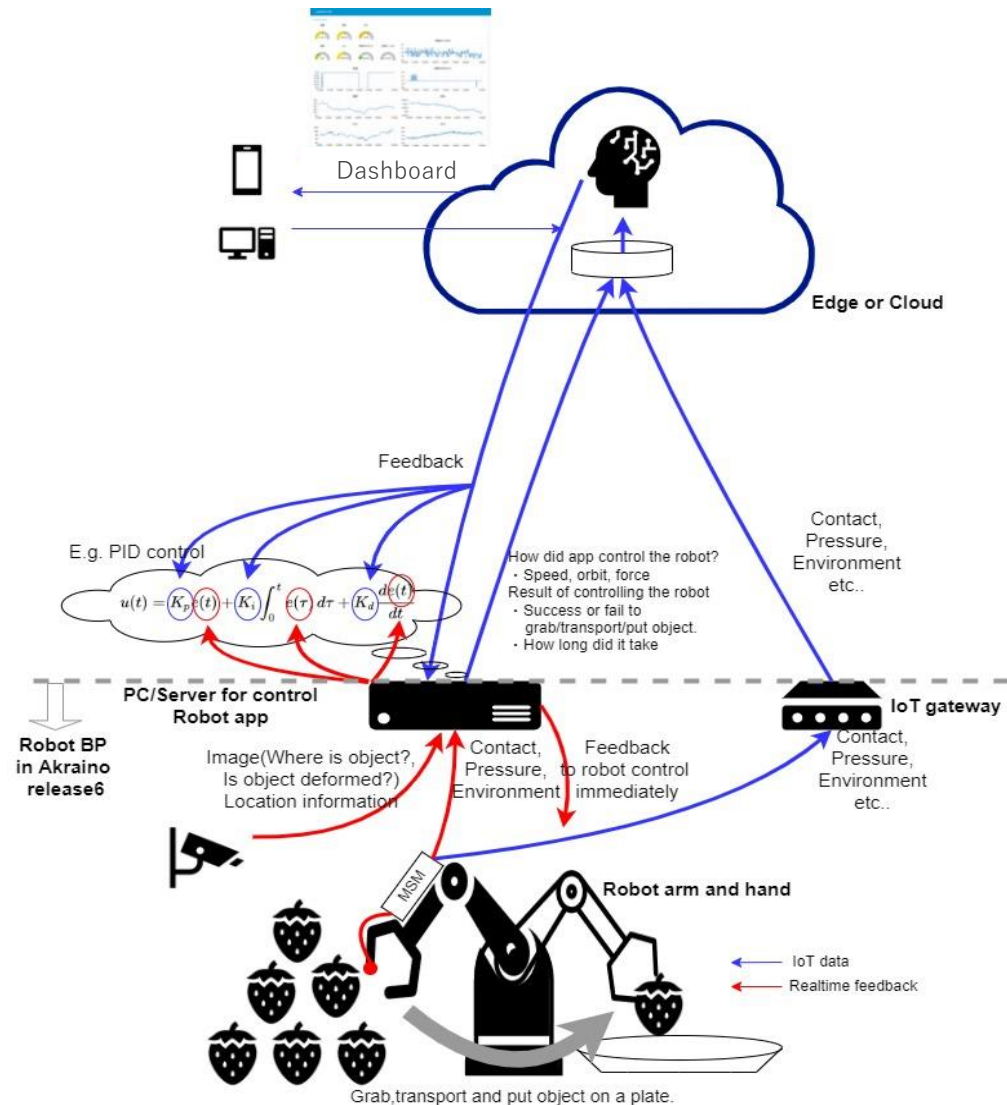


Figure: Enhance Robot basic architecture based on SSES Blueprint

Acknowledgements

This work was supported by the Cabinet Office (CAO) and the Cross-ministerial Strategic Innovation Promotion Program (SIP), “An intelligent knowledge processing infrastructure, integrating physical and virtual domains” (funding agency: NEDO).



Cabinet Office

<https://www.cao.go.jp/index-e.html>



NEDO New Energy and Industrial Technology
Development Organization

<https://www.nedo.go.jp/english/index.html>



SIP Cross-ministerial Strategic
Innovation Promotion Program

<https://www.jst.go.jp/sip/en/index.html>



Thanks

