

Introduction to IoTtalk

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NCTU



The Evolution of Communication

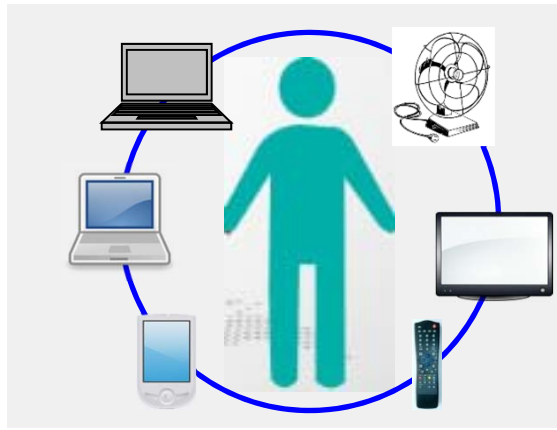
H2H → H2M → M2M

A humans talks to the other humans.



The human talks to the other humans.

A human directly controls the machines.



The human manipulates the machine himself.

A machine automatically controls the other machines.



Machines have logic or intelligence to manipulate other machines. That is, **IoT devices can talk to each other (IoTtalk).**

Why IoT Industry does not fly?

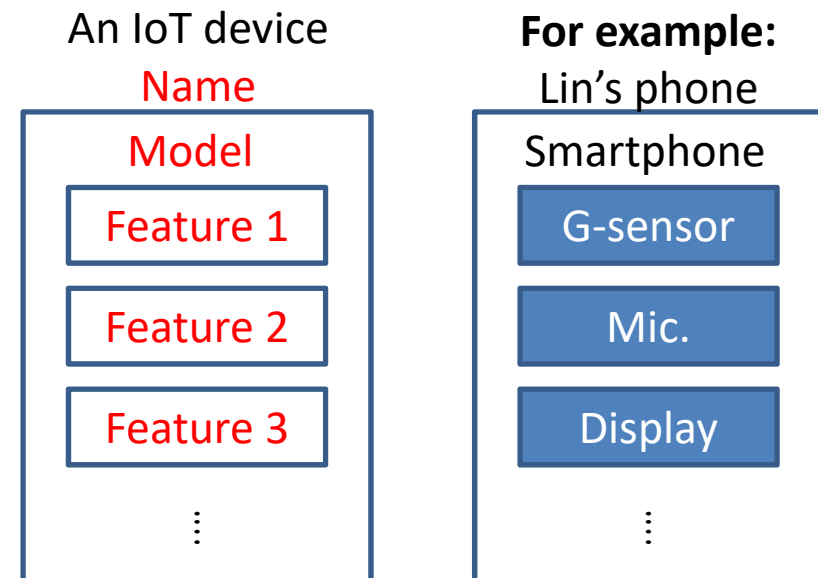
- 1. Too many complicated standards that are difficult to interoperate**
- 2. Most IoT devices only talk to few “other” IoT devices**
- 3. Most IoT applications are difficult to maintain**
- 4. Only developers can play the games, the users are unlikely to participate (automatic home vs smart home)**

A Possible Solution

- 1. To modulize the IoT development platform**
- 2. To provide “local” intelligence at the IoT device’s side (Edged Computed AI)**

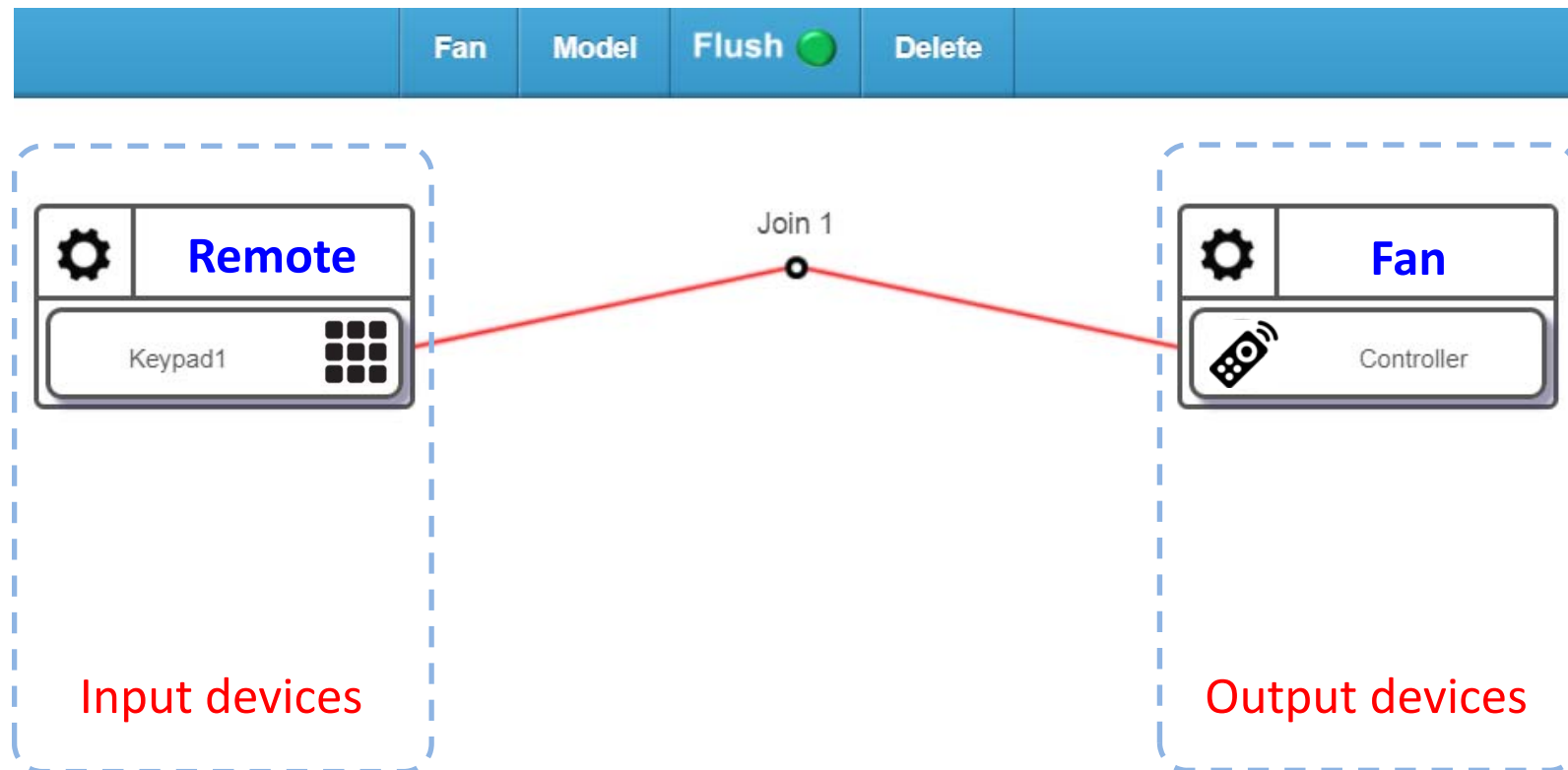
What is IoTtalk?

- **IoTtalk** is an IoT device management tool
- **IoT management concept**
 - **Device Feature**
 - The function or capability which an IoT can provide
 - **Device Model**
 - A set of device features
 - A device model refers to a specific product
 - **Device name**
 - The name of a specific product



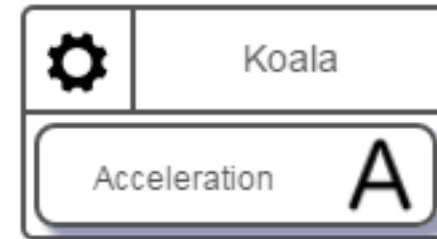
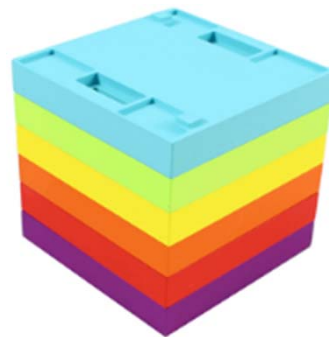
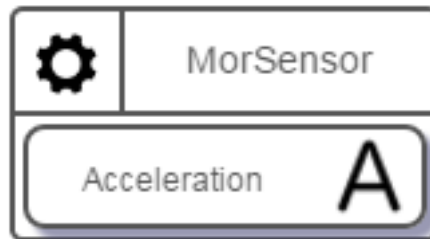
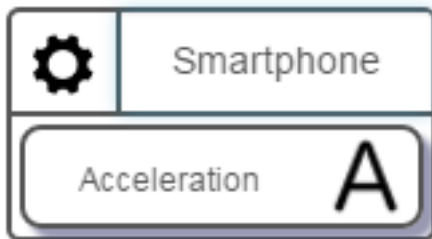
Why is IoTtalk?

- Applications can simply develop with lower efforts
- Simple and intuitive GUI
- Application development without real devices is feasible



Applications can simply develop with lower efforts

- Reusable DF modules
 - Even they are different IoT devices



Easy to Deploy and Operate



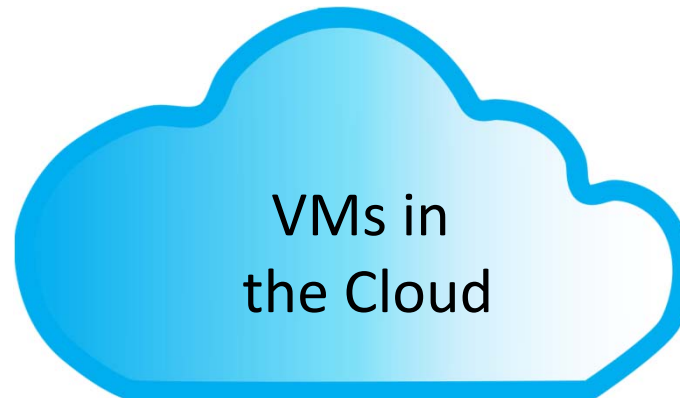
Intel Edison



Raspberry Pi3



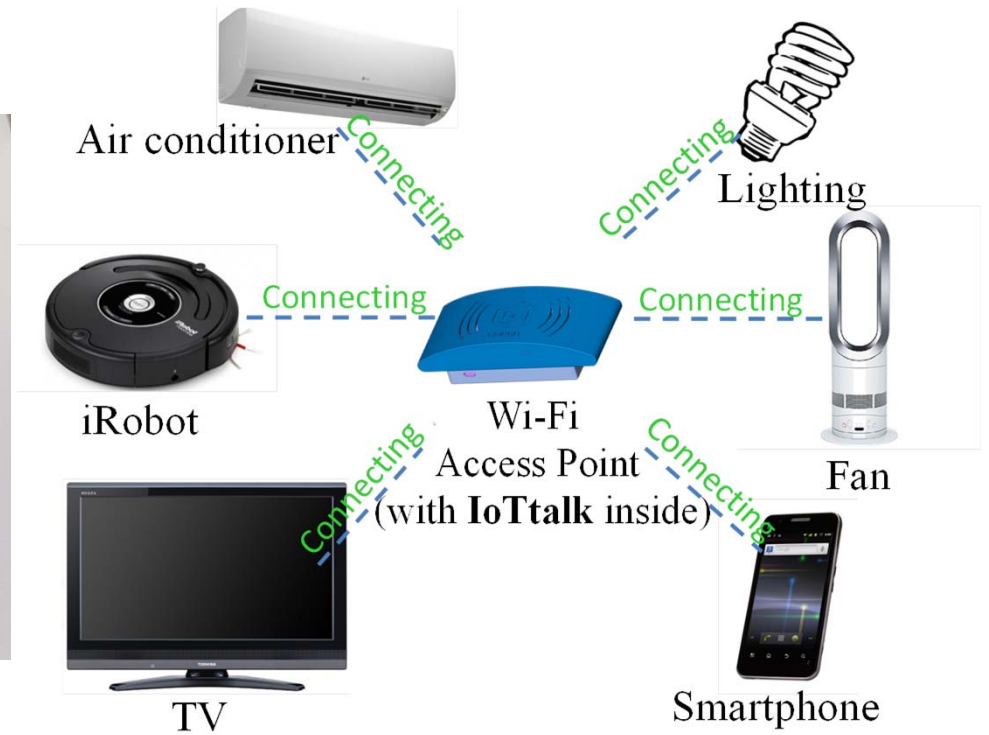
PC server



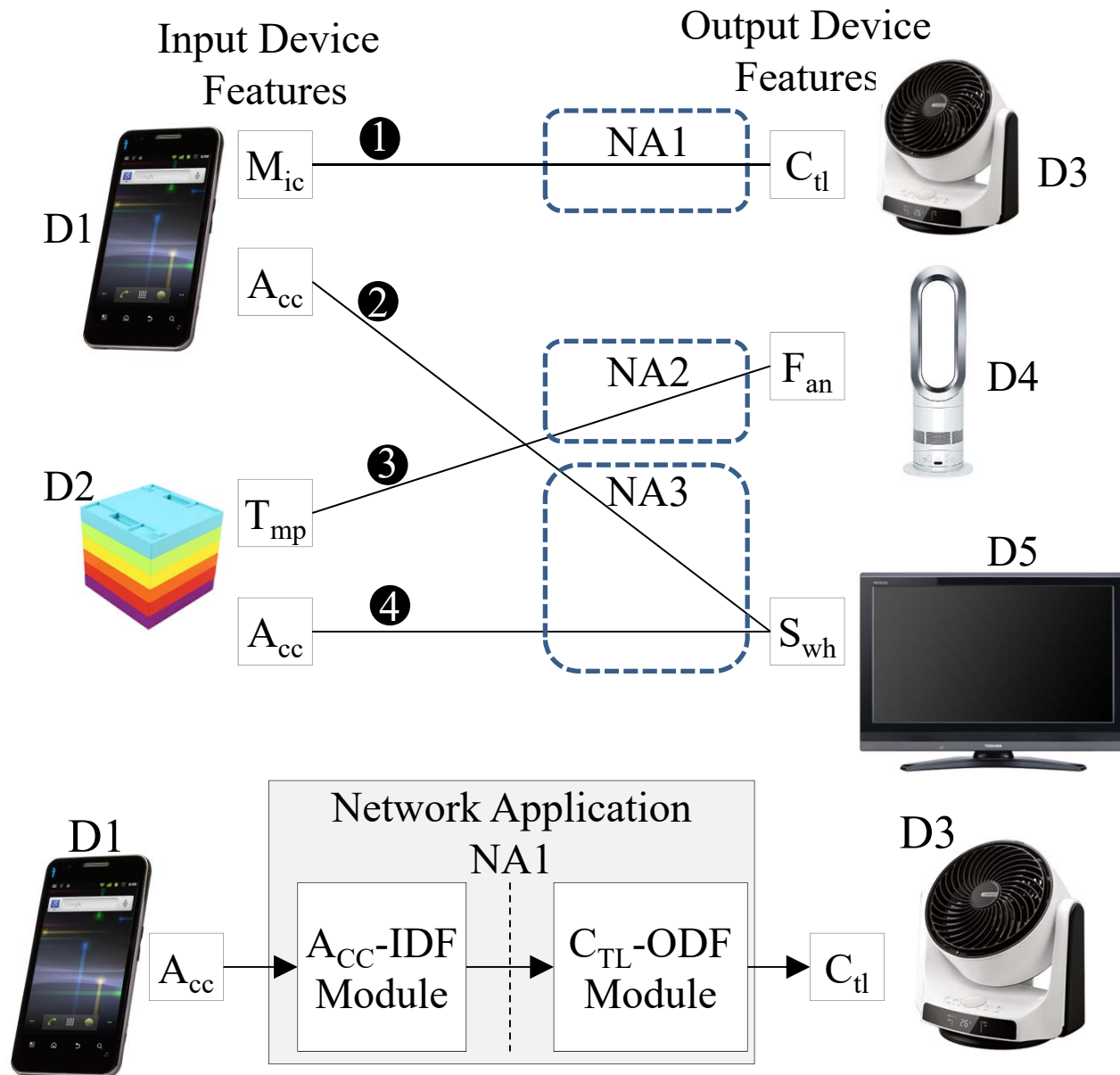
For example, you can try

<http://140.113.199.200:7788/connection>

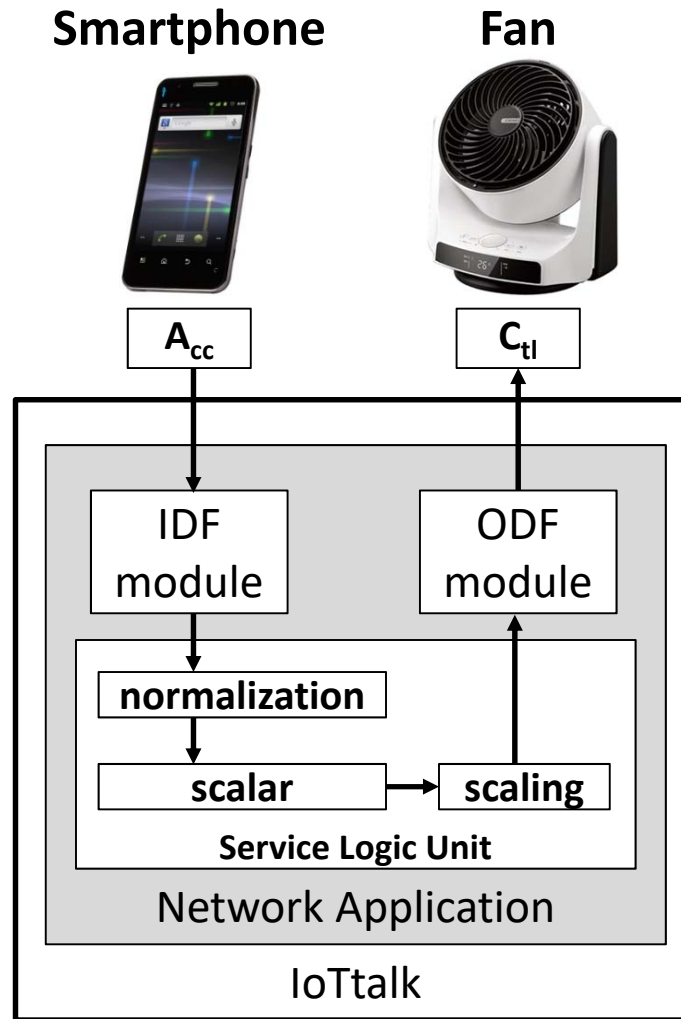
GorbitTalk



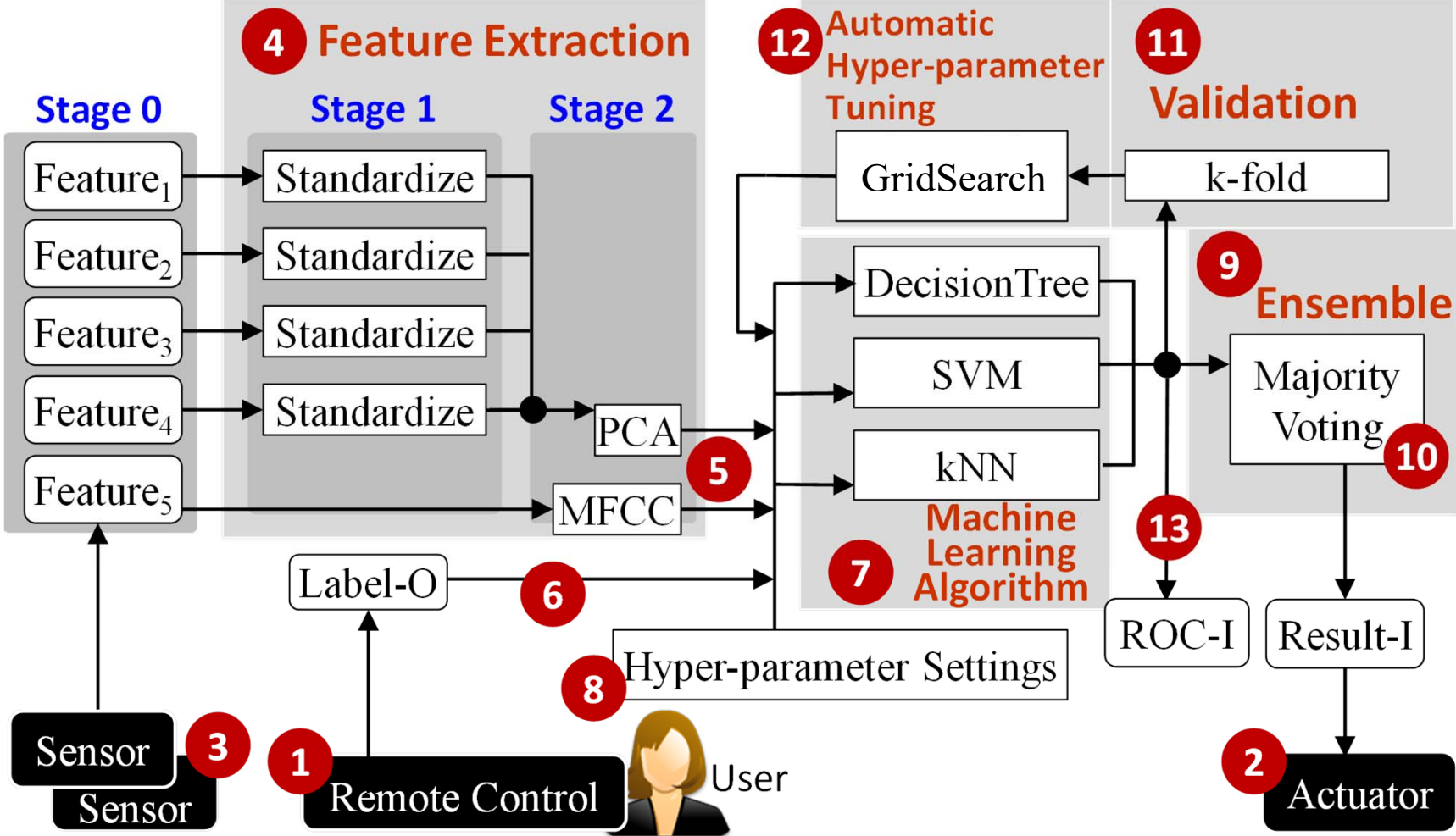
Appliance Connections with IoTtalk



Connection and Mapping Manner

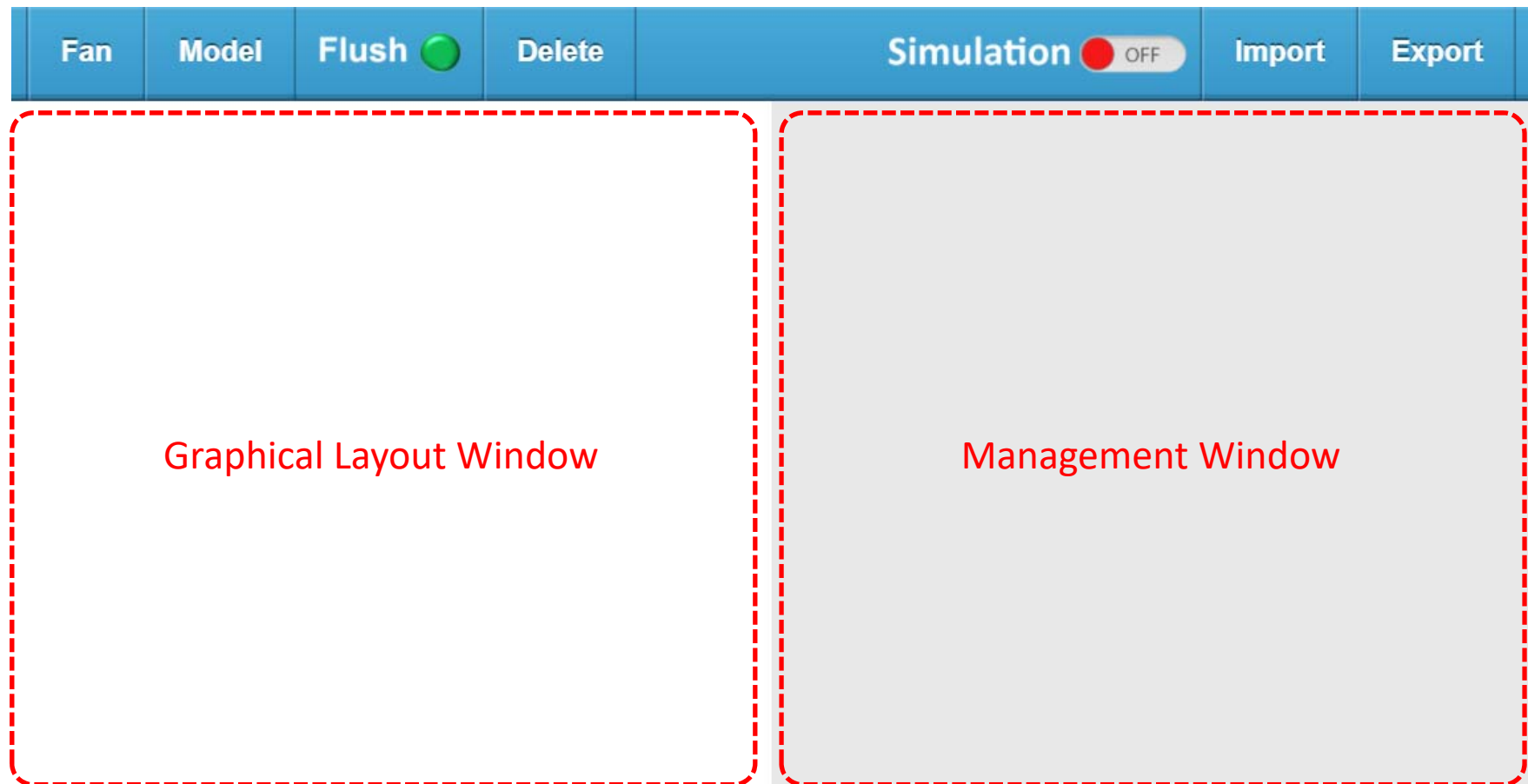


AItalk: IoTtalk with Machine Learning



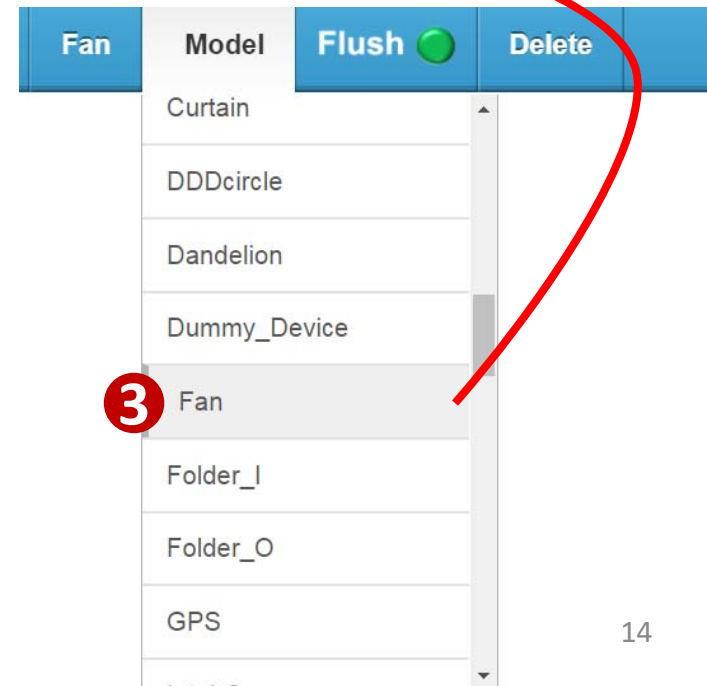
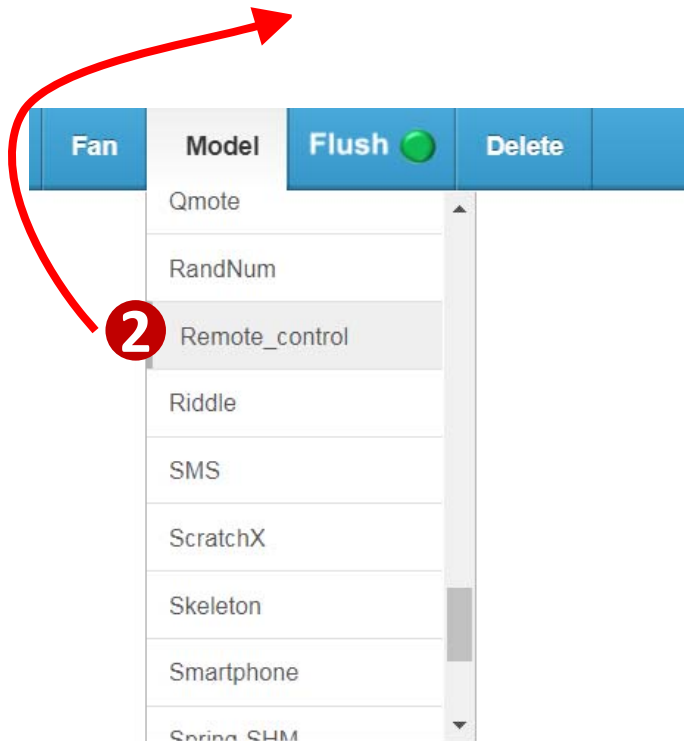
The IoTtalk GUI

- Create a Project “Fan”



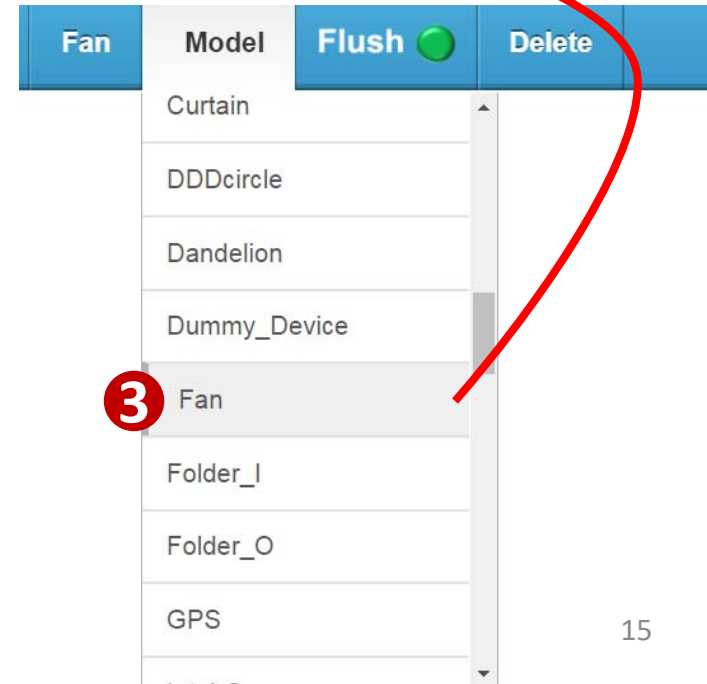
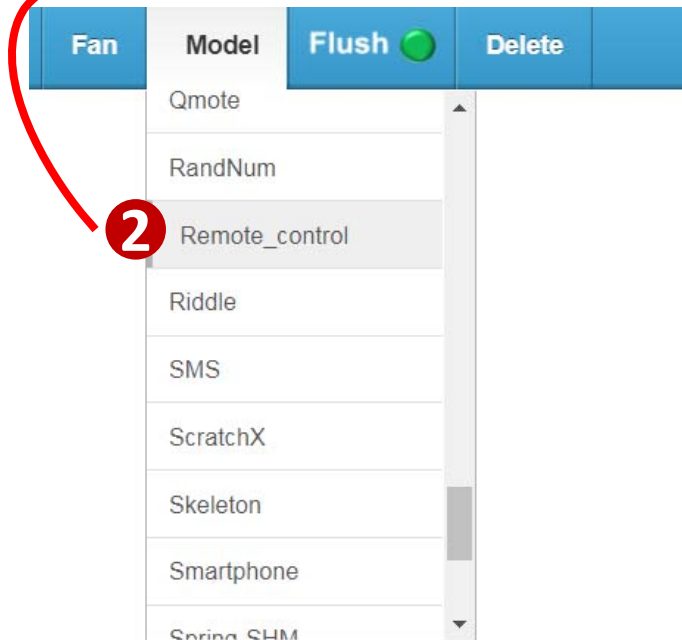
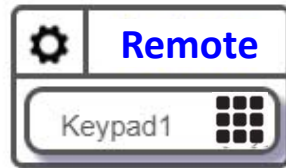
Device Model Selection

- The user selects device models from the “Model” drop-down list.



Device Model Selection

- The user selects device models from the “Model” drop-down list.



Fan Control using IoTtalk

- Click the device features of the two devices to create a link between them.
- Then, the user controls the Fan using Keypad through IoTtalk

The screenshot displays the IoTtalk interface. At the top, there is a blue navigation bar with buttons for 'Fan', 'Model', 'Flush' (with a green indicator), 'Delete', 'Simulation' (with a red indicator and 'OFF' text), 'Import', and 'Export'. Below this, a diagram shows two device icons: 'Remote' (with a 'Keypad1' feature) and 'Fan' (with a 'Controller' feature). A red line connects them through a central point labeled 'Join 1'. Red circles with the numbers '4' and '5' are placed over the 'Keypad1' and 'Controller' features respectively. To the right, a configuration panel for 'Join 1' is visible, containing two tables. The first table is for 'Controller (IDF)' and the second is for 'Fan (ODF)'. Below the diagram, a 'CHIMEI Fan' is shown with a keypad (1-9, *, 0, #) and a blue arrow labeled 'Remote' pointing towards it.

Connection Name: Delete Save


Controller (IDF) Delete		
Keypad1	Type	Function
x1	sample ▾	disabled ▾

Fan (ODF) Delete	
Controller	Function
y1	disabled ▾

CHIMEI Fan

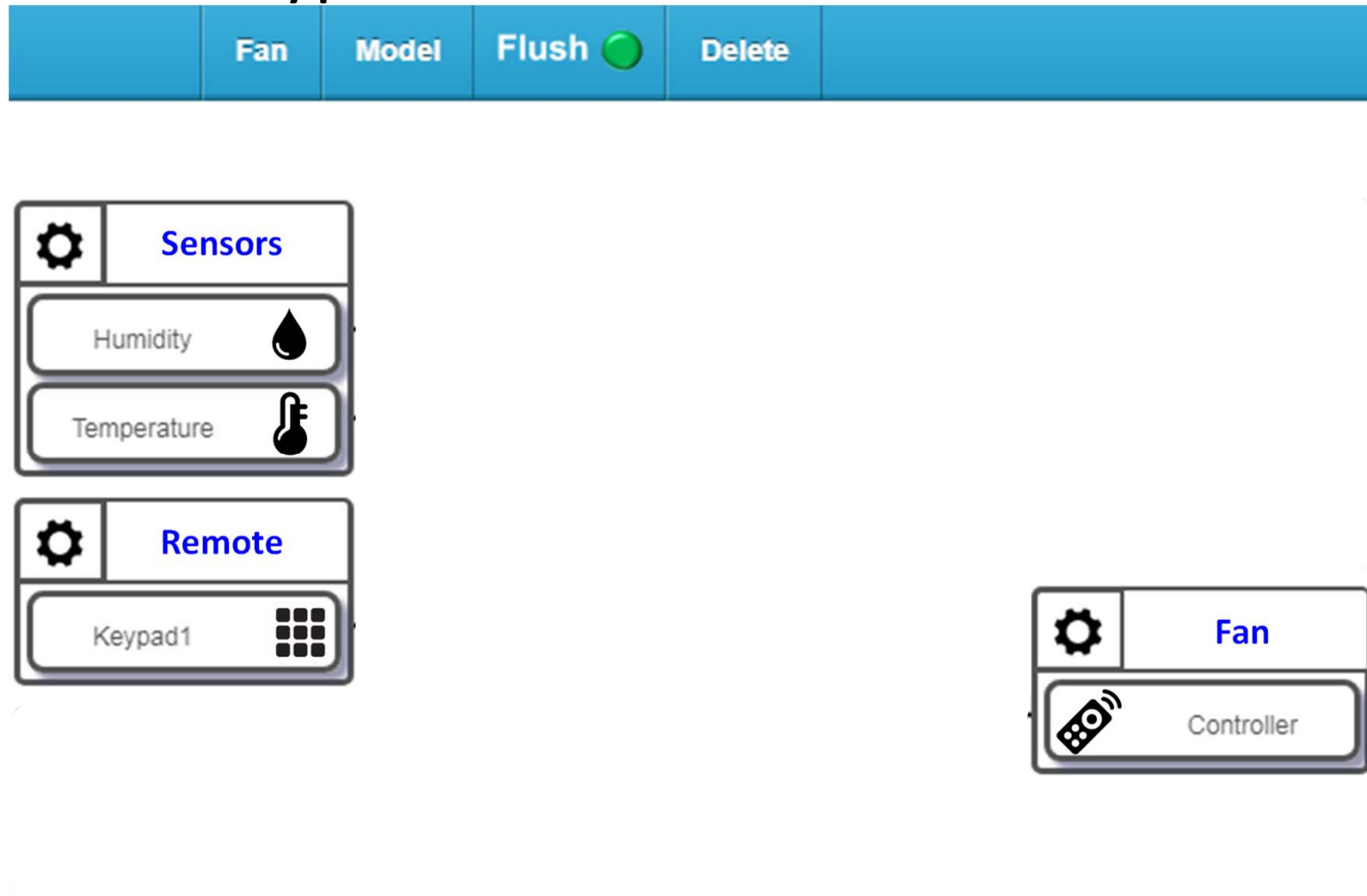
1 2 3
4 5 6
7 8 9
* 0 #

Remote



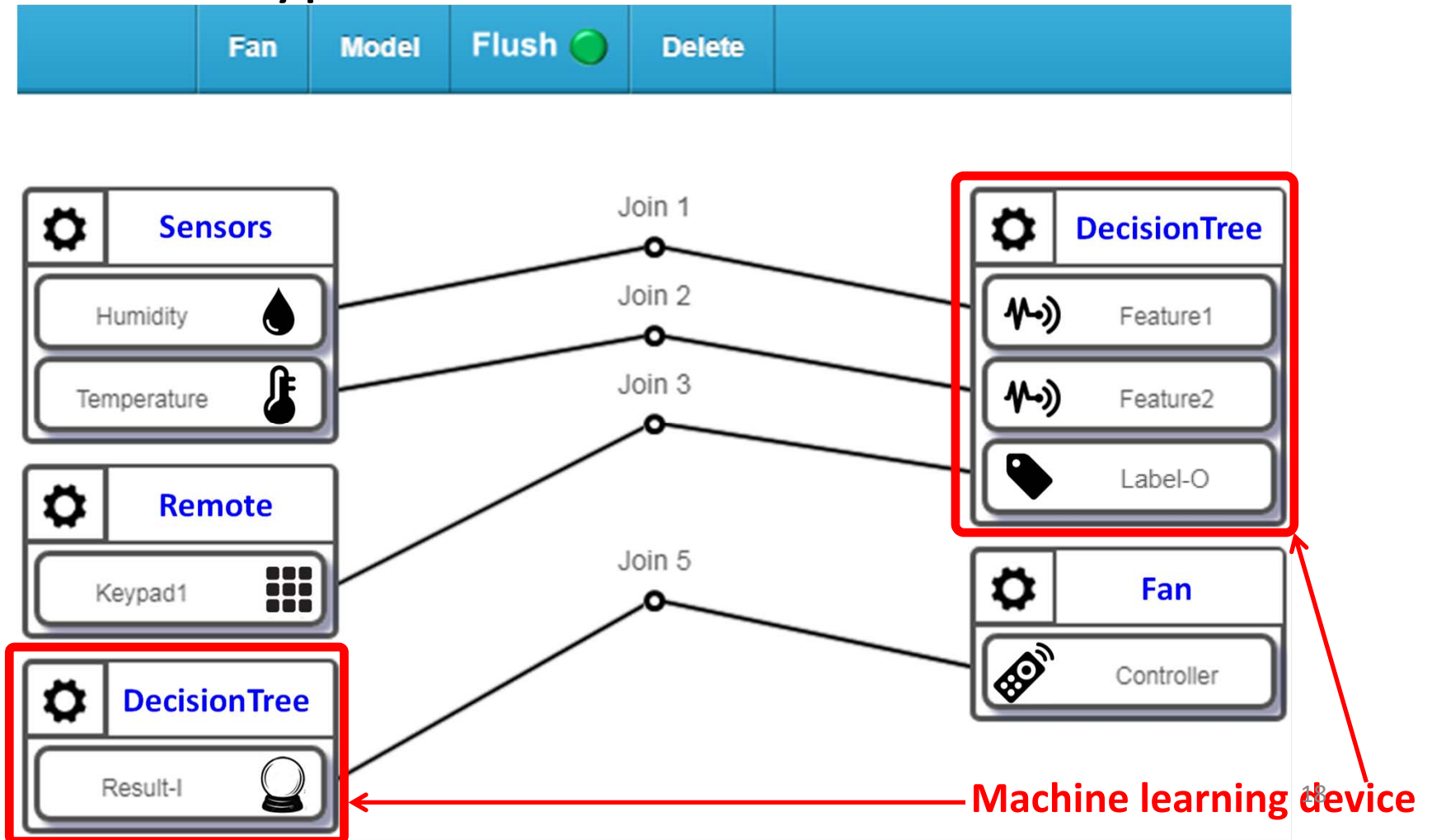
Smart Fan using IoTtalk with Machine Learning

- Insert a machine learning device and sensors between Keypad and Fan.



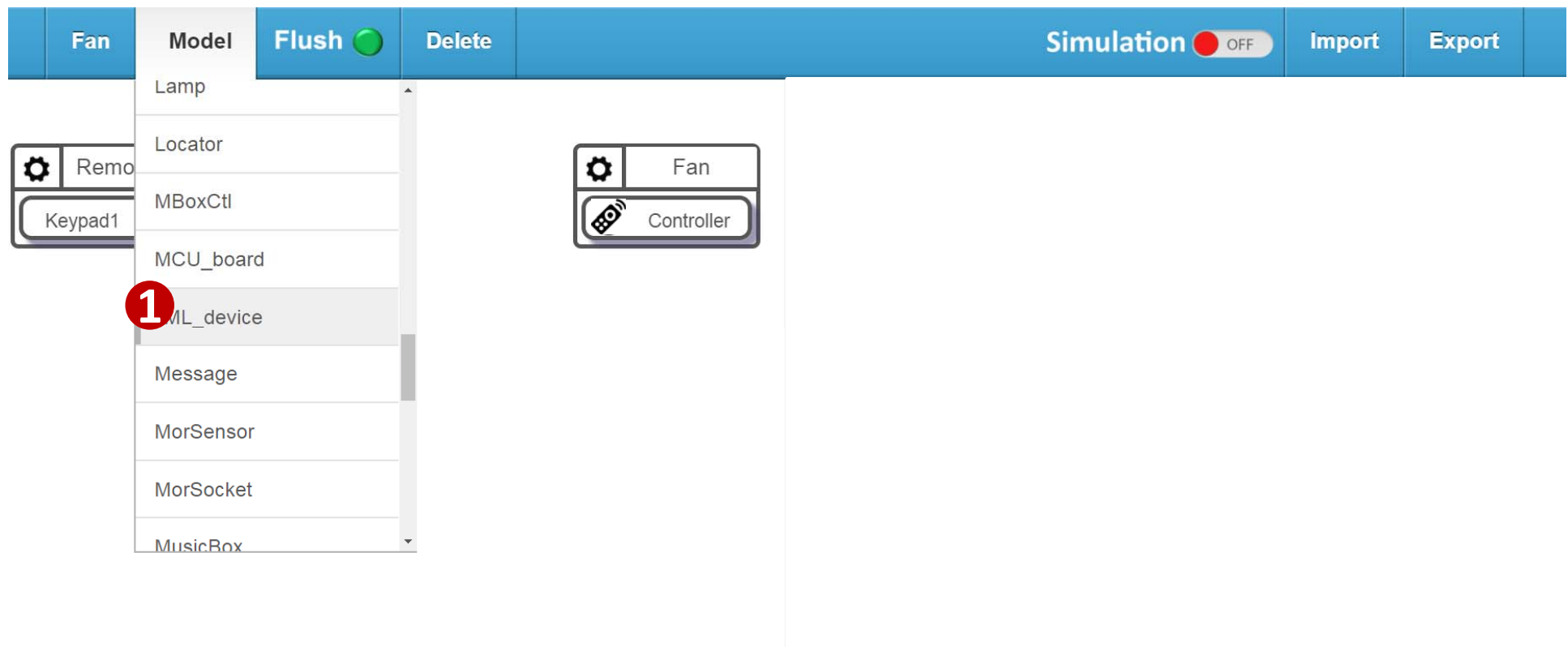
Smart Fan using IoTtalk with Machine Learning

- Insert a machine learning device and sensors between Keypad and Fan.



Add a Machine Learning Device

1. Select “ML_device” from the Model menu
2. Select the number of “Feature” for ML_device
3. Click “Save” to add the machine learning device



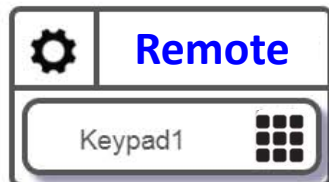
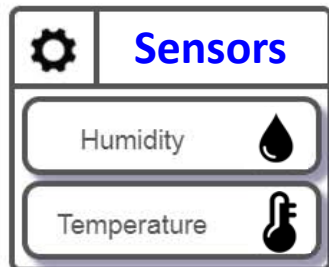
Add a Machine Learning Device

1. Select “ML_device” from the Model menu
2. Select the number of “Feature” for ML_device
3. Click “Save” to add the machine learning device

The screenshot displays a software interface for configuring a Machine Learning Device. The top toolbar contains buttons for 'Fan', 'Model', 'Flush', 'Delete', 'Simulation', 'Import', and 'Export'. A dropdown menu is open under the 'Model' button, listing various device types: Lamp, Locator, MBoxCtl, MCU_board, ML_device (highlighted), Message, MorSensor, MorSocket, and MusicBox. To the right, the configuration panel for the selected device is shown. It includes sections for 'DA Installation' (with email and phone number fields), 'ML_device' configuration, 'Input Device Features' (with 'Result-I' set to 1), and 'Output Device Features' (with 'Feature' set to 2 and 'Label-O' set to 1). A 'Save' button is located at the bottom of the configuration panel.

Add a Machine Learning Device

4. Click the sign “gear” of the ML_device



Add a Machine Learning Device

4. Click the sign “gear” of the ML_device
5. Click the “Extra Setup” button, a window pops up for detailed configuration

The image shows a control panel interface with a blue header bar containing buttons for 'Fan', 'Model', 'Flush' (with a green indicator), and 'Delete'. Below the header, there are three main device configuration cards: 'Sensors', 'Remote', and 'ML_device'. The 'ML_device' card is highlighted with a red circle containing the number '4', pointing to a gear icon. To the right, a detailed configuration window for the 'ML_device' is shown, featuring sections for 'DA Installation', 'Input Device Features', and 'Output Device Features'. At the bottom of this window are 'Save', 'Delete', and 'Extra Setup' buttons, with the 'Extra Setup' button highlighted by a red circle containing the number '5'.

Fan Model Flush Delete

Sensors

- Humidity
- Temperature

Remote

- Keypad1

ML_device

- Result-I

ML_device

- Feature1
- Feature2
- Label-O

Fan

- Controller

DA Installation

Send DA To Email Address: Please enter

Send DA To Phone Number: Please enter

ML_device

Input Device Features

Result-I 1

Output Device Features

Feature 2

Label-O 1

Save Delete Extra Setup

Device Name : DecisionTree ▾

Feature extraction : Stages 2 ▾

Stage 0 2 ▾

Stage 1 2 ▾

	1	2		
Standardize ▾	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	1
Standardize ▾	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2

Stage 2 1 ▾

	1	2		
Sparse coding ▾	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> 1 2

select all select none reverse select

Algorithm : Classification ▾

SVM

kNN

Decision Trees show/hide setting

Decision Trees

max_depth :

user define show/hide setting

Validation : k-fold cross validation ▾ k :

Ensemble : Decision Trees ▾

Training data

Simulation ● OFF Import Export

DA Installation

Send DA To Email Address: send

Send DA To Phone Number: send

ML_device

Input Device Features

Result-I 1 ▾

Output Device Features

Feature 2 ▾

Label-O 1 ▾

Save Delete Extra Setup

6

Device Name : DecisionTree

Feature extraction : Stages 2

Stage 0 2

Stage 1 2

Standardize 1 2 1

Standardize 1 2 2

Stage 2 1

Sparse coding 1 2 1 2

select all select none reverse select

Algorithm : Classification

SVM

kNN

Decision Trees show/hide setting

Decision Trees

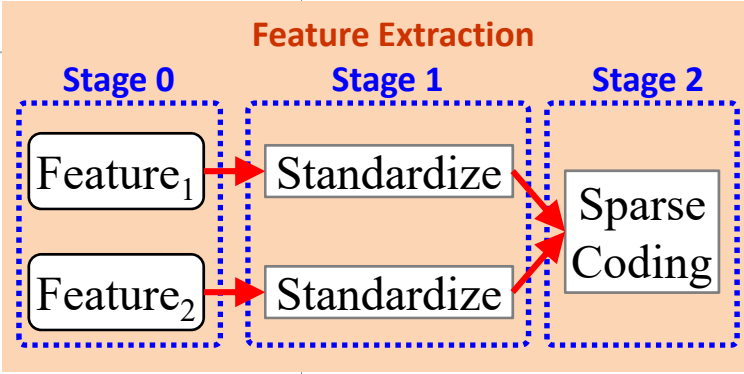
max_depth : 6

user define show/hide setting

Validation : k-fold cross validation k : 10

Ensemble : Decision Trees

Training data



Simulation OFF Import Export

DA Installation

Send DA To Email Address: send

Send DA To Phone Number: send

ML_device

Input Device Features

Result-I 1

Output Device Features

Feature 2

Label-O 1

Save Delete Extra Setup

Device Name : DecisionTree

Feature extraction : Stages 2

Stage 0 2

Stage 1 2

Standardize 1 2 1

Standardize 1 2 2

Stage 2 1

Sparse coding 1 2 1 2

select all select none reverse select

Algorithm : Classification

SVM

kNN

Decision Trees show/hide setting

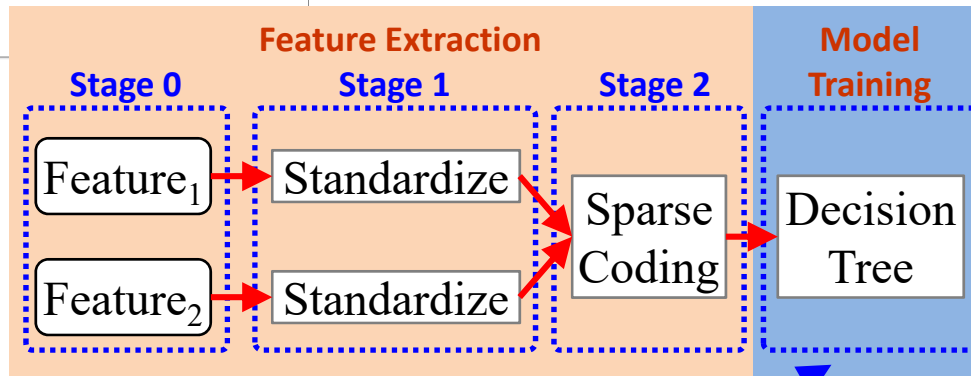
Decision Trees
max_depth : 6

user define show/hide setting

Validation : k-fold cross validation k : 10

Ensemble : Decision Trees

Training data



Simulation OFF Import Export

DA Installation

Send DA To Email Address: send

Send DA To Phone Number: send

ML_device

Input Device Features

Result-I 1

Output Device Features

Feature 2

Label-O 1

Save Delete Extra Setup

Device Name : DecisionTree

Feature extraction : Stages 2

Stage 0 2

Stage 1 2

Standardize 1 2 1

Standardize 1 2 2

Stage 2 1

Sparse coding 1 2 1 2

select all select none reverse select

Algorithm : Classification

SVM

kNN

Decision Trees show/hide setting

Decision Trees

max_depth : 6

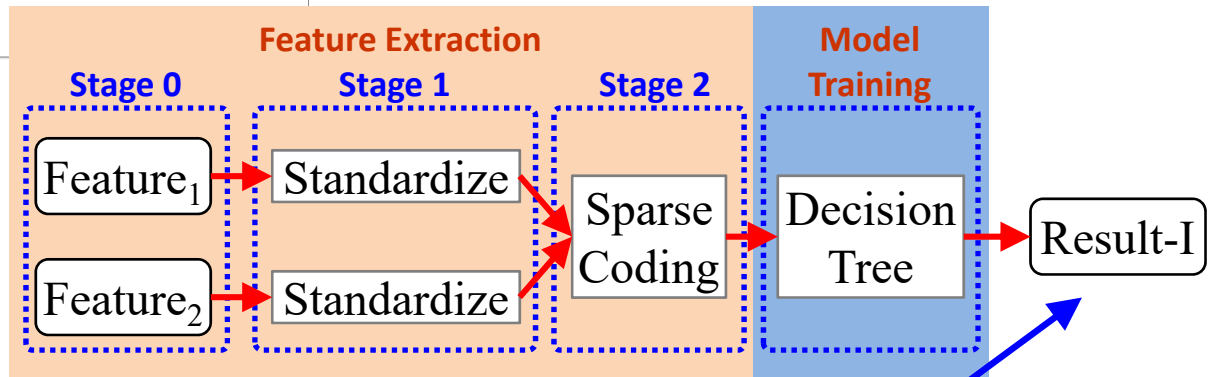
user define show/hide setting

8 Performance Evaluation

Validation : k-fold cross validation k : 10

Ensemble : Decision Trees

Training data



Simulation OFF Import Export

DA Installation

Send DA To Email Address: Please enter your email address send

Send DA To Phone Number: Please enter your phone number send

ML_device

Input Device Features

Result-I 1

Output Device Features

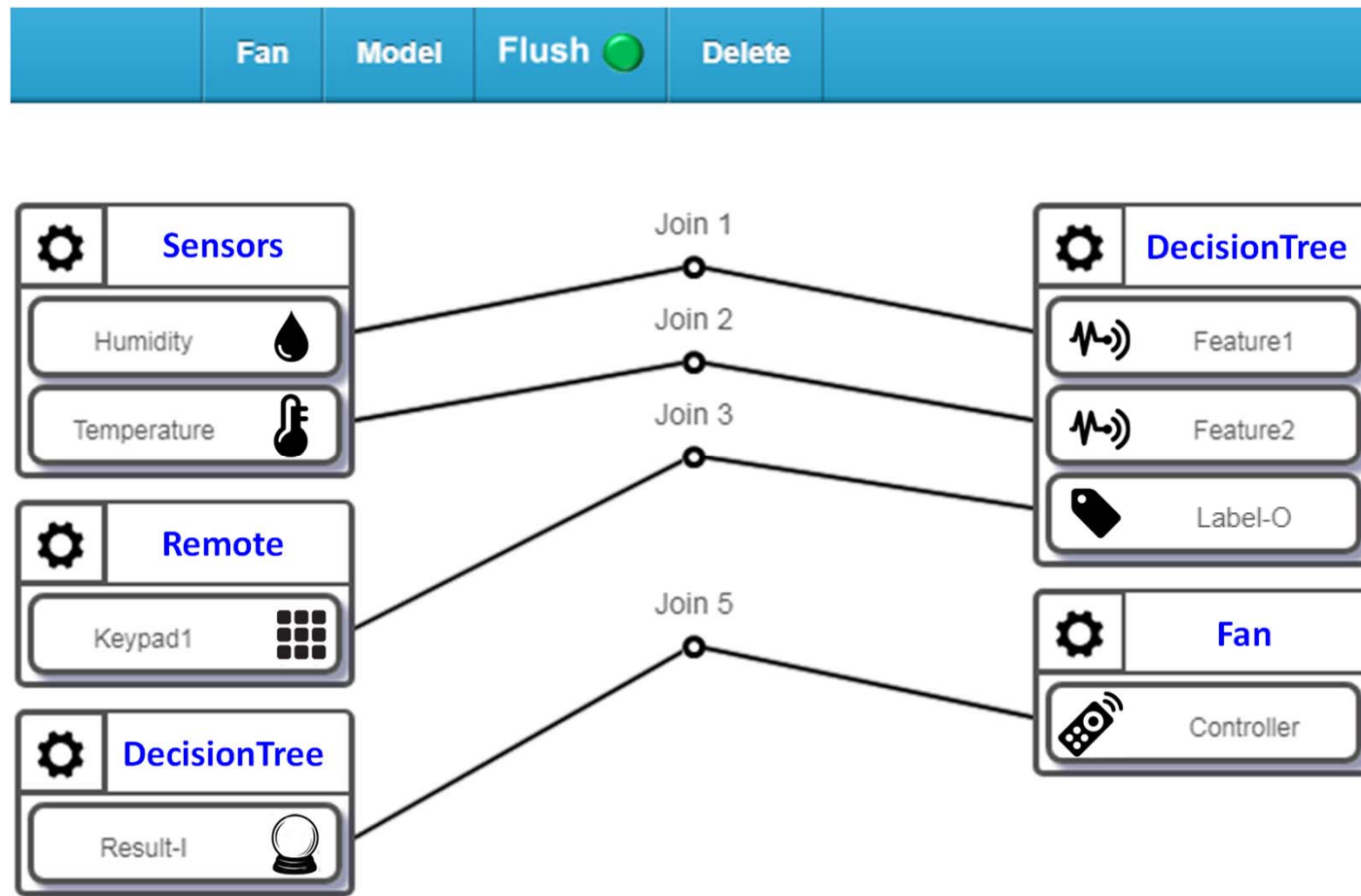
Feature 2

Label-O 1

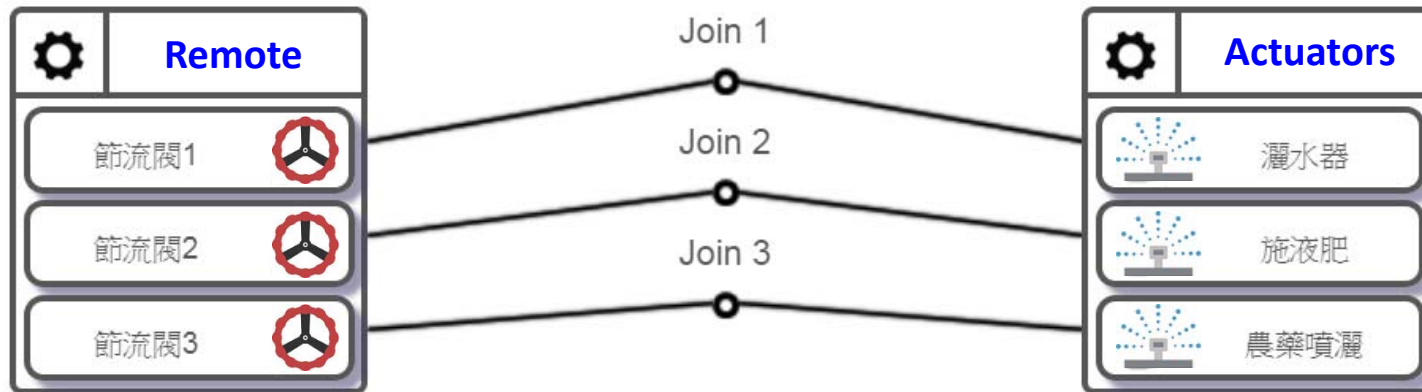
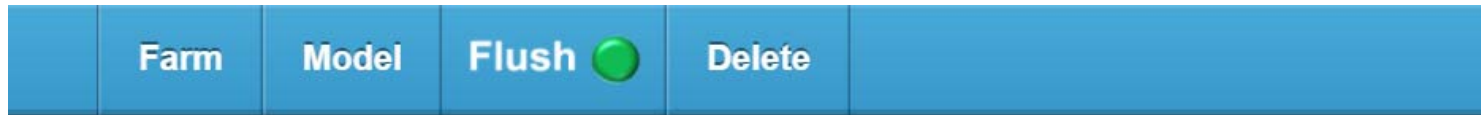
Save Delete Extra Setup

AI Smart Fan

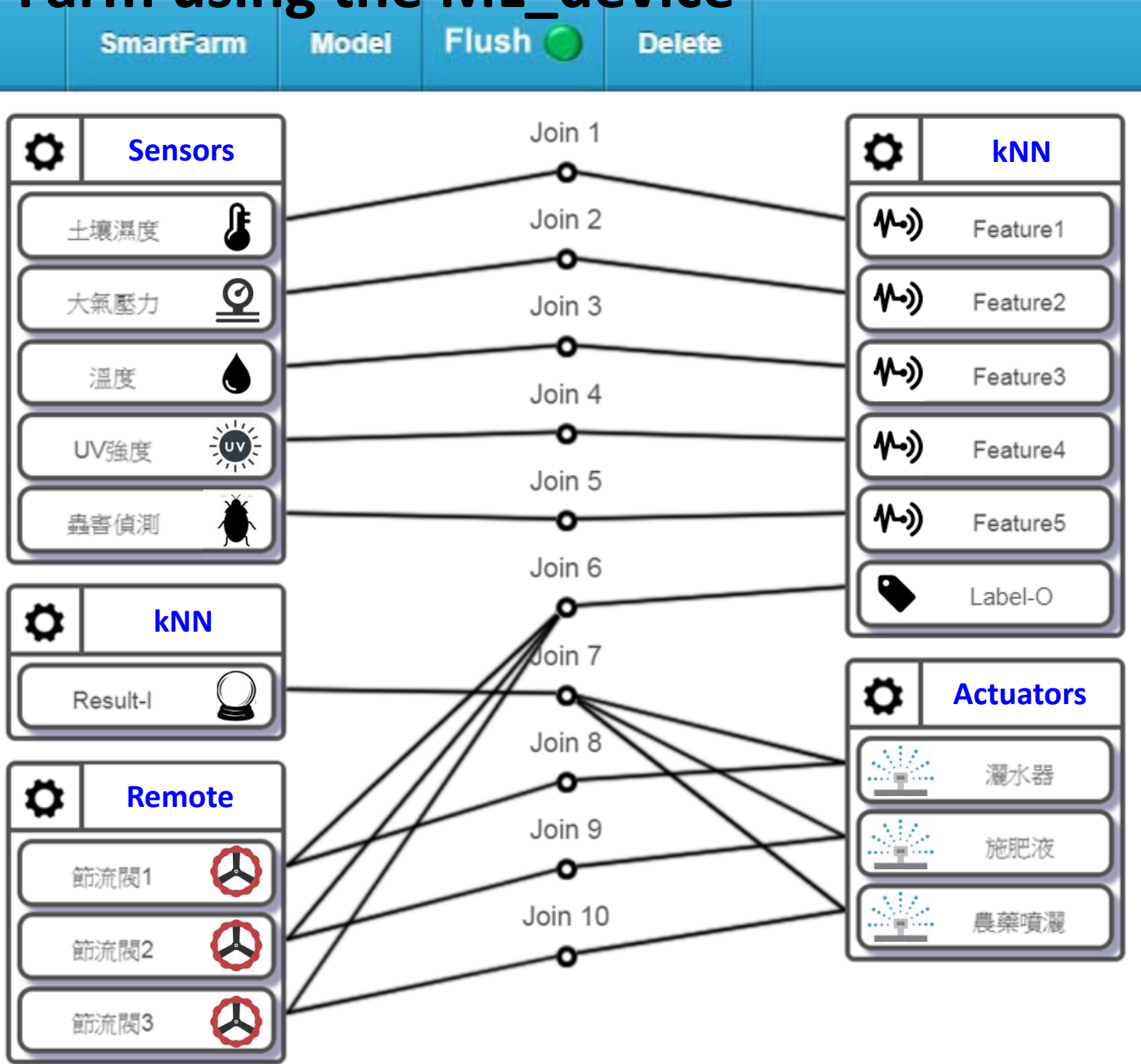
- Create links between Sensor, Decision, and Fan.
- The ML_device predicts results based on user's behaviors after finishing model training



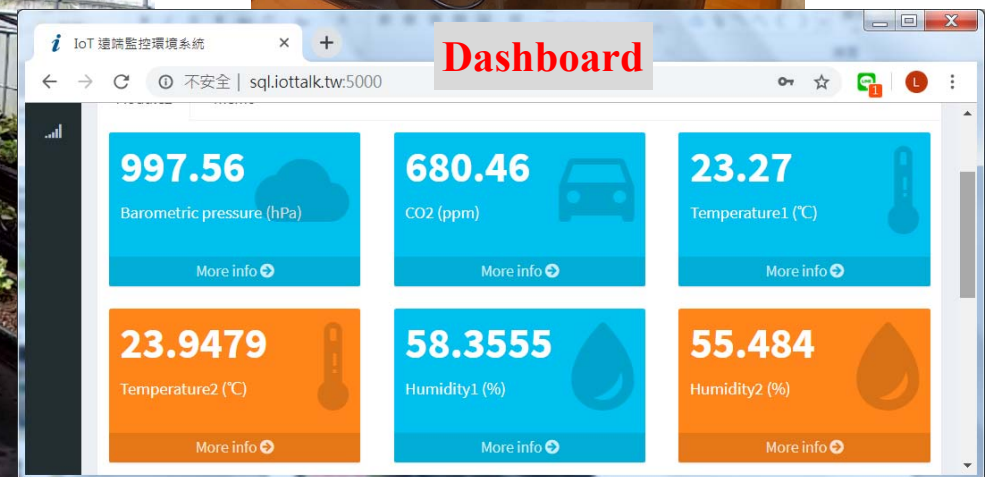
Farm Management using IoTtalk



Smart Farm using the ML_device



Smart Farm



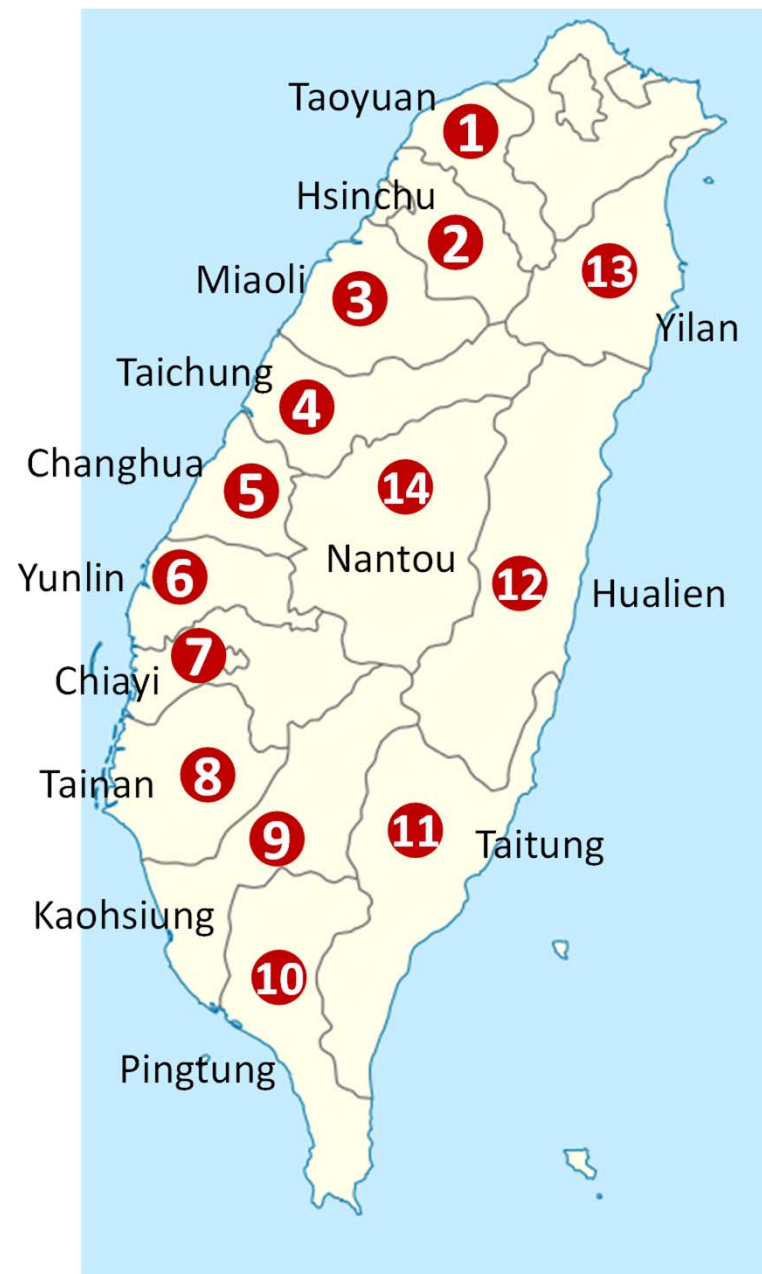
Disease Predation in Agriculture

- Rice Blast

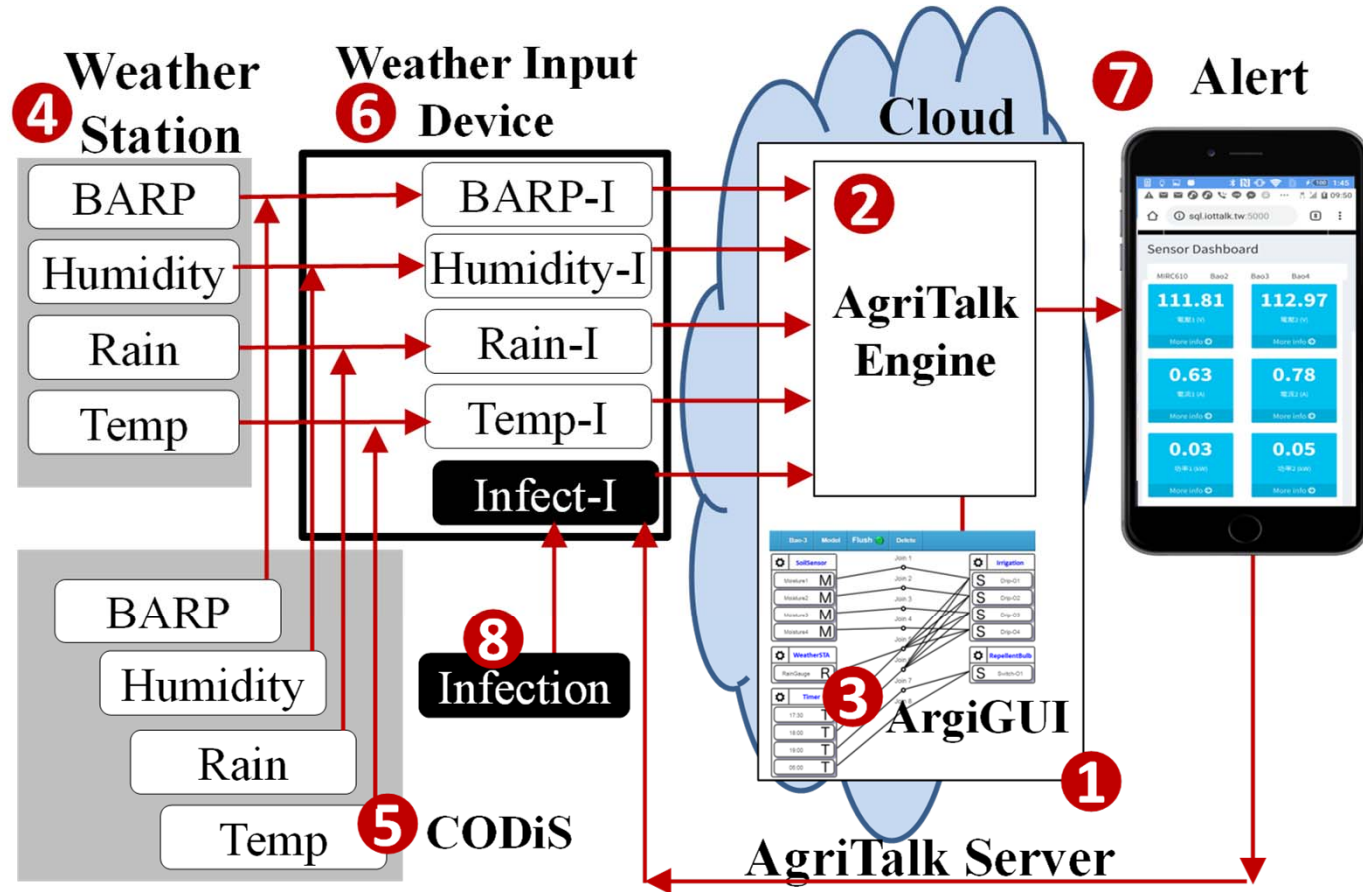


Rice Blast Detection

- The weather historical data come from CODiS
- The corresponding labels come from the Bureau of Animal and Plant Health Inspection and Quarantine

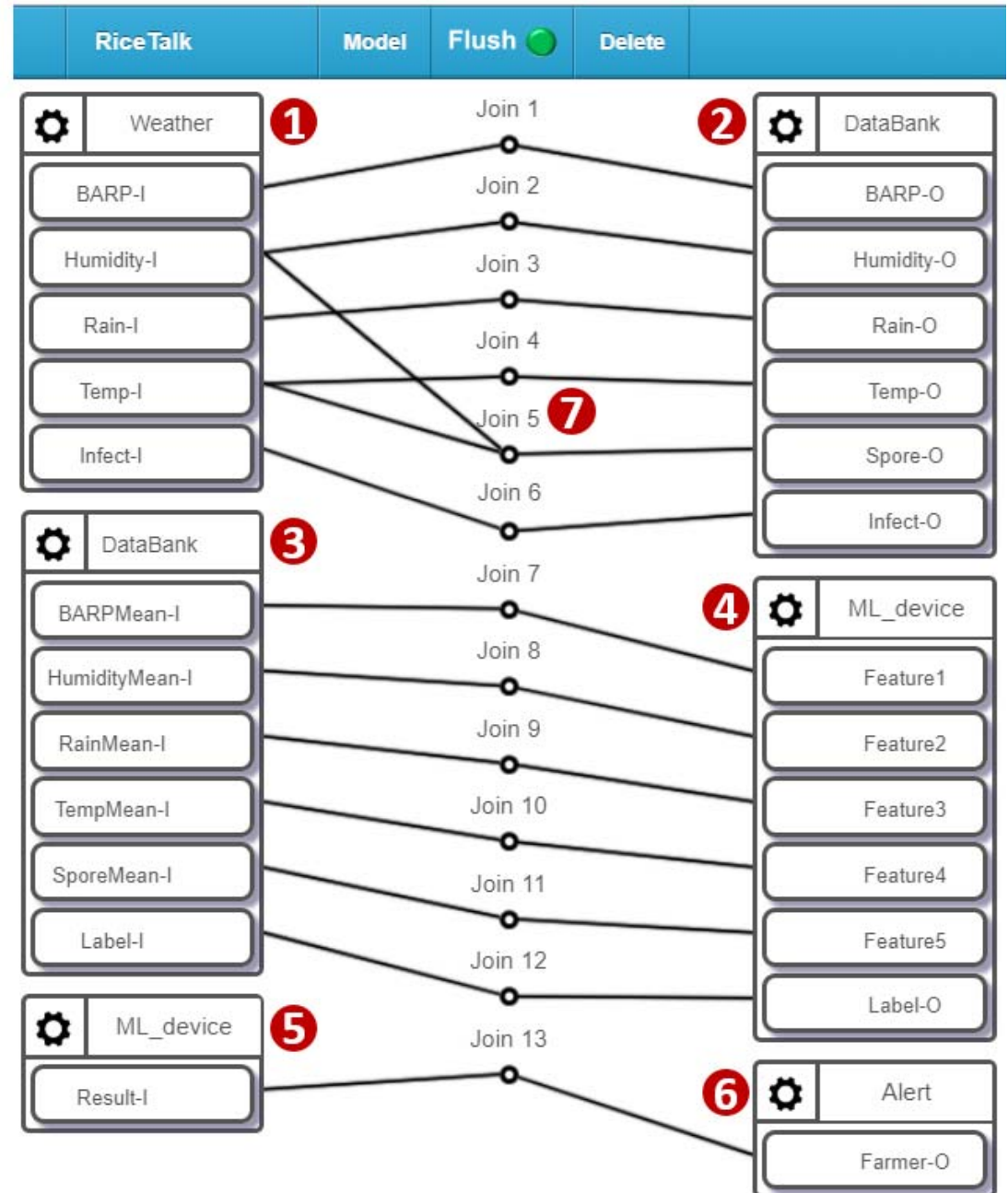


RiceTalk: Non-Image Rice Blast Detection

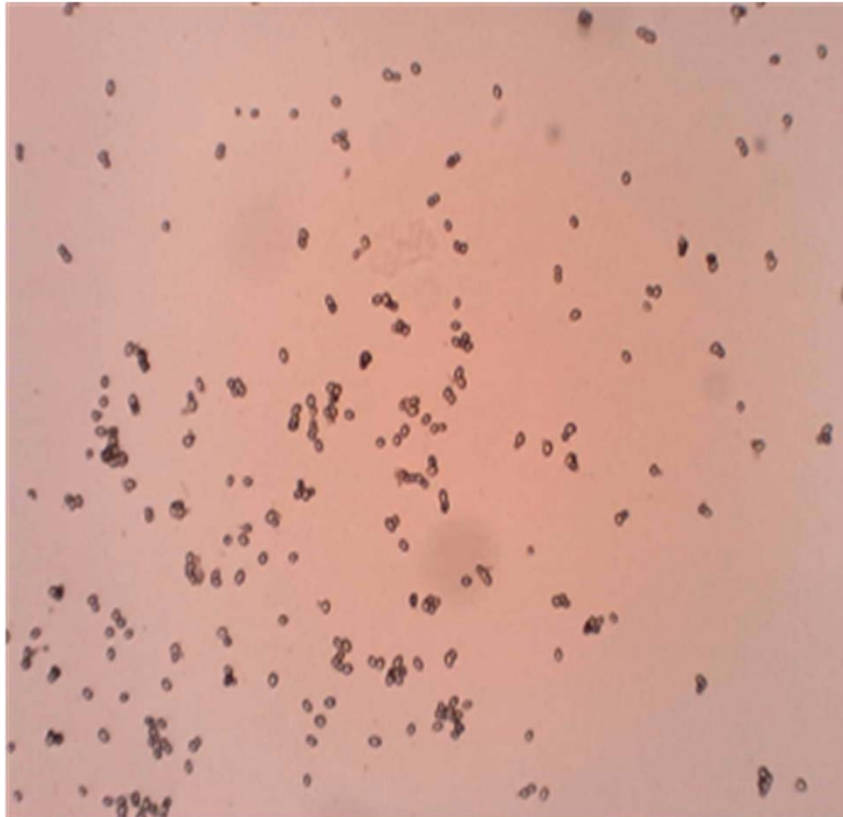


Rice Blast Detection

- Time series data
 - DataBank slices data
 - Observation period
- TensorFlow
 - CNN
- Positive prediction : 89.4%



Spore Germination Prediction

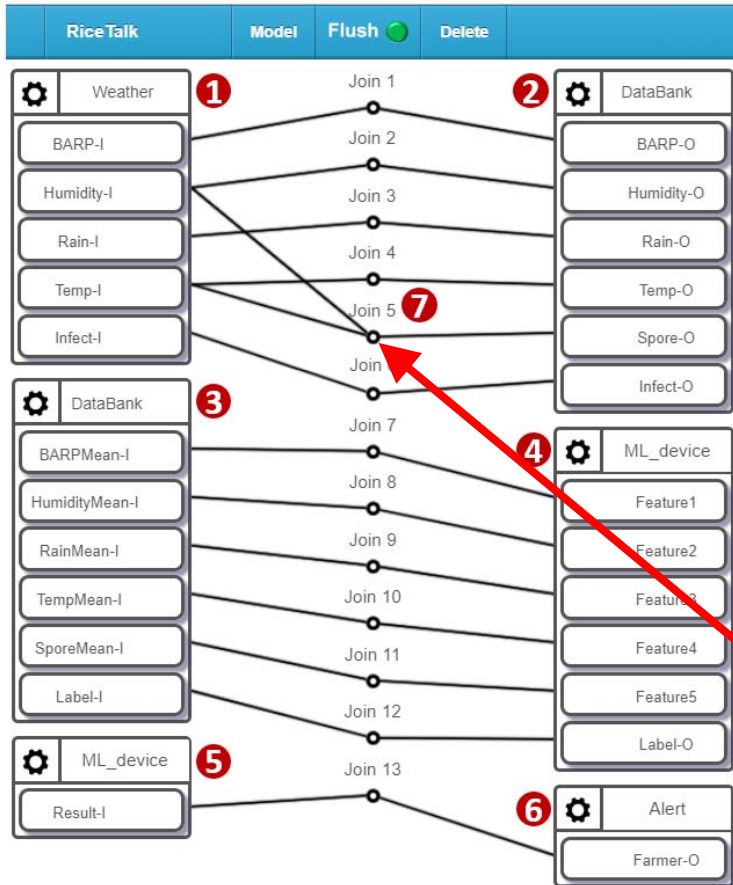


No Spore Germination



Spore Germination

Spore Germination Prediction



Function Management Close

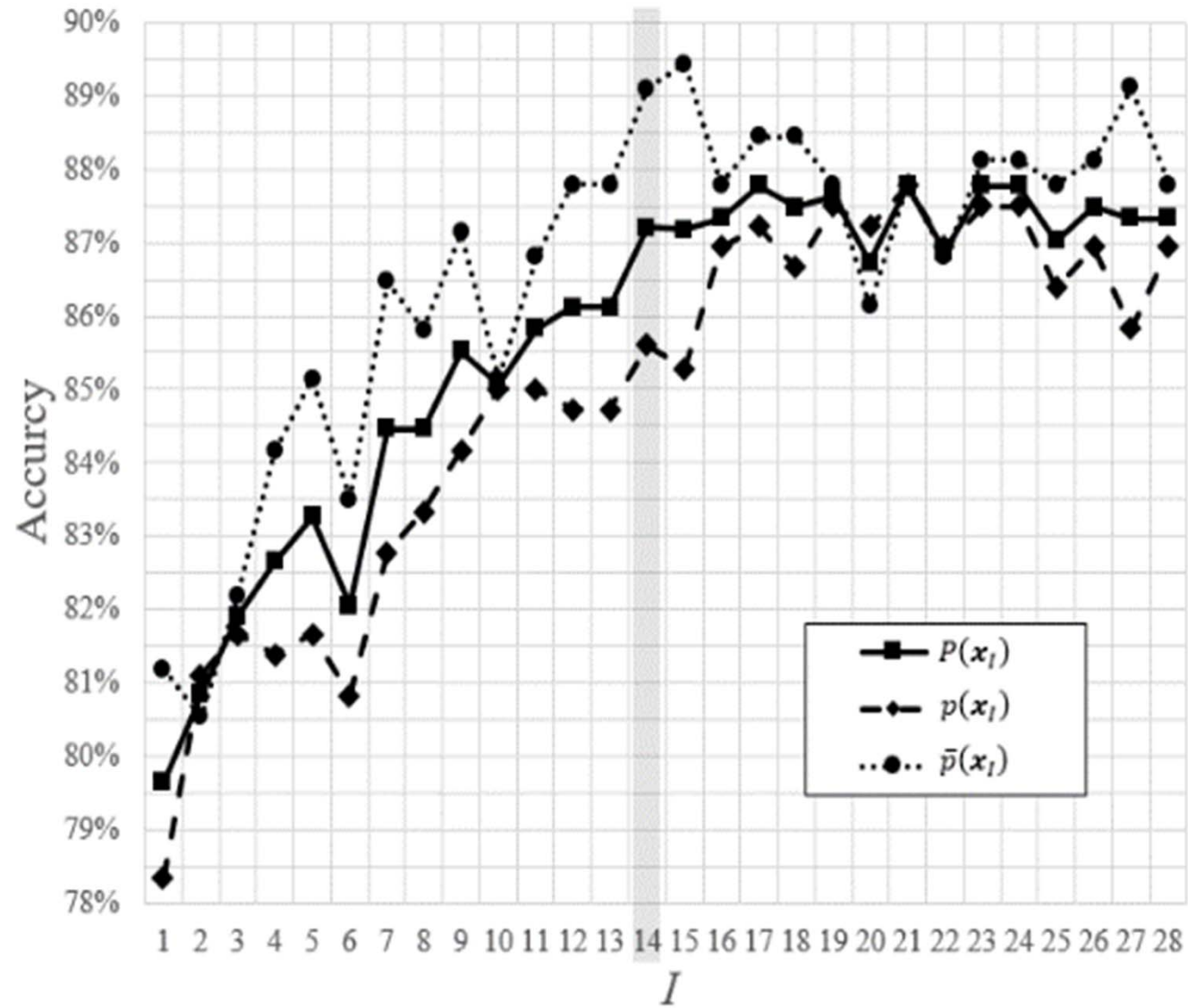
Selected Function:

Version: Delete Save

Include non-DF arguments

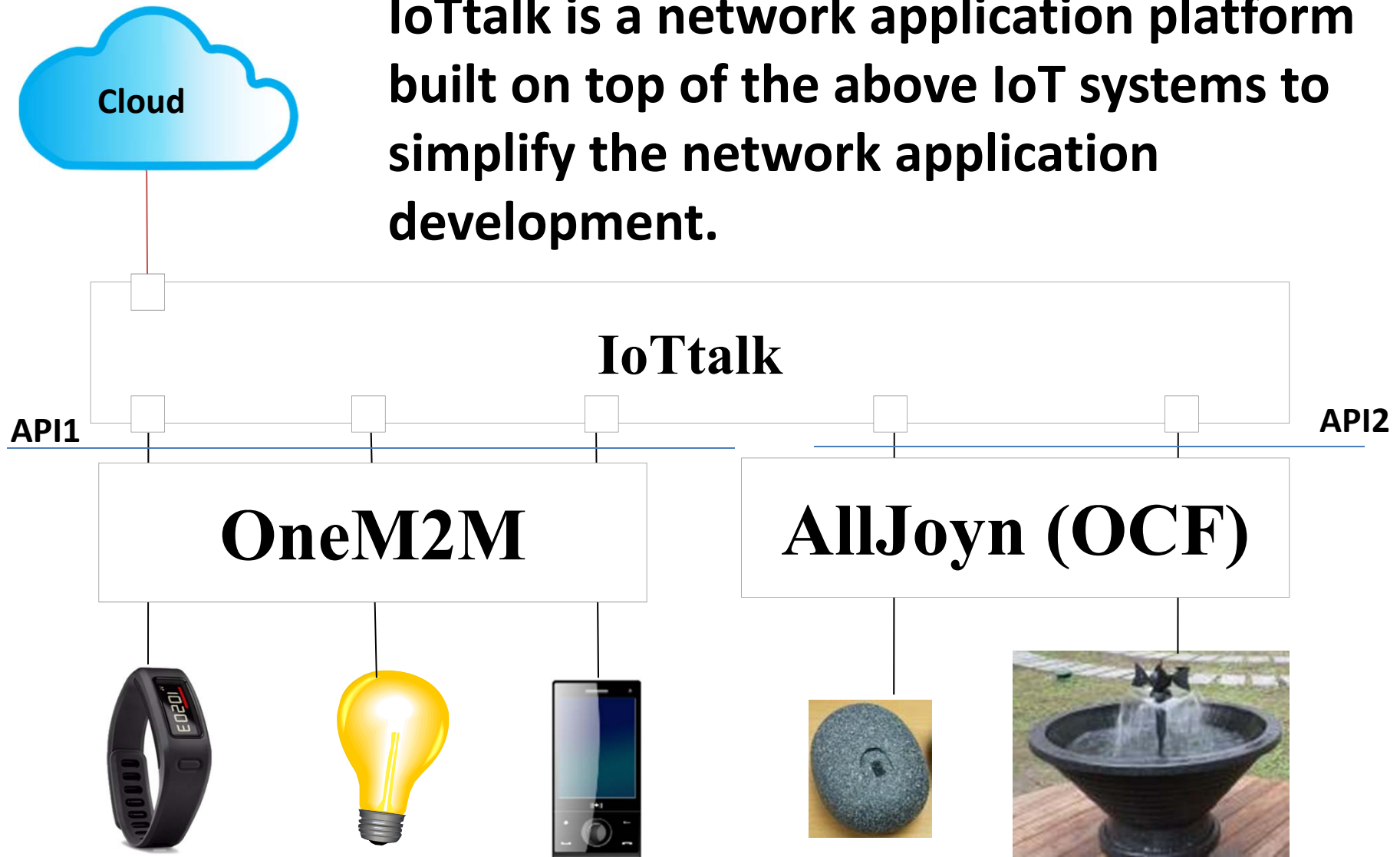
```
def run(*args):           Line 1
    humidity = args[0] / 100 Line 2
    temp = args[1]         Line 3
    f_humidity = 0.1143 * math.exp(6.6027 * x) Line 4
    f_temp = -0.0078 * x**3 + 0.2806 * x**2 + 1.6665 * x + 0.27 Line 5
    return f_humidity * f_temp / 100 Line 6
```

Observation Period



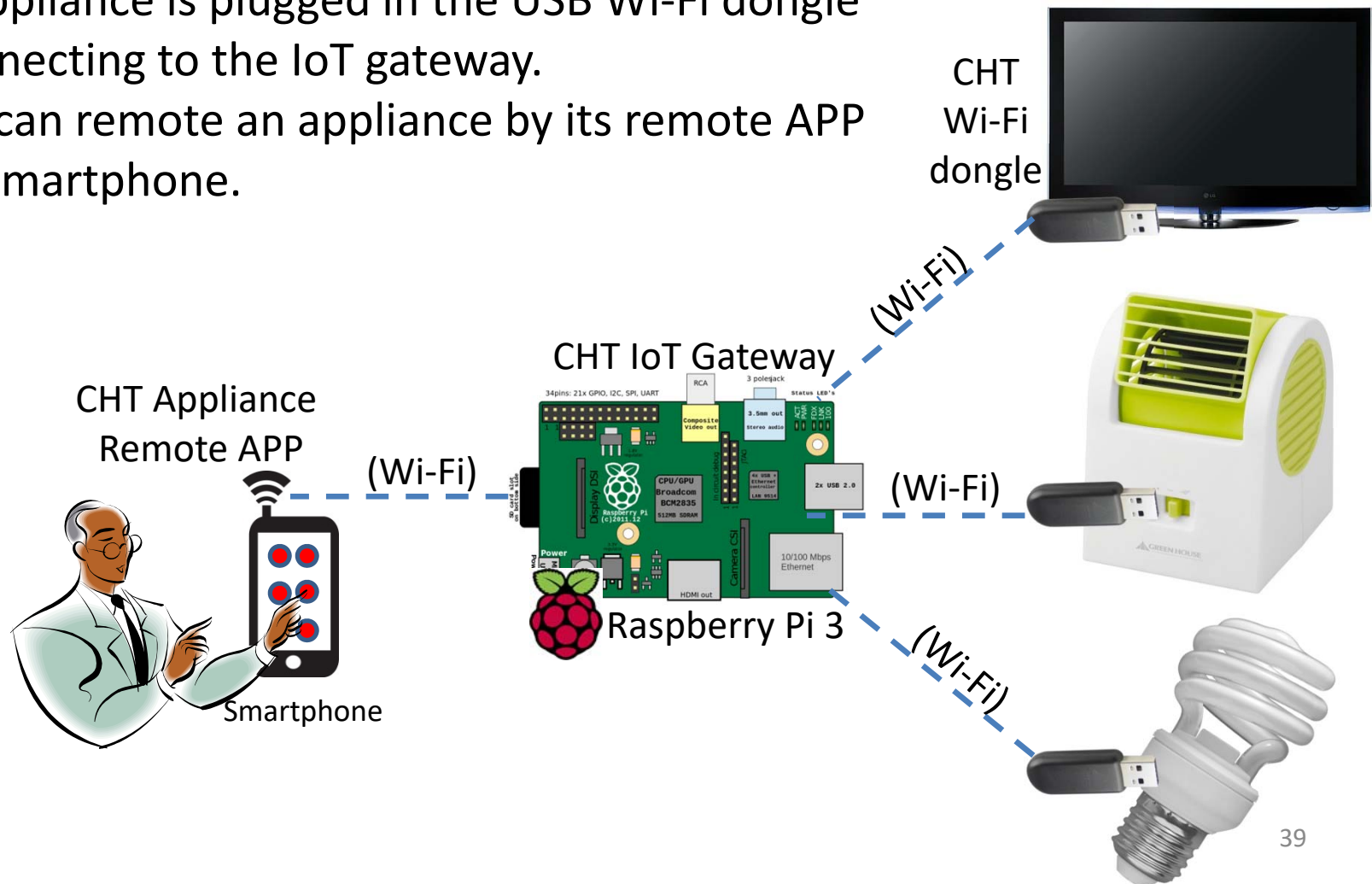
Inter-Platform Communication

IoTtalk is a network application platform built on top of the above IoT systems to simplify the network application development.

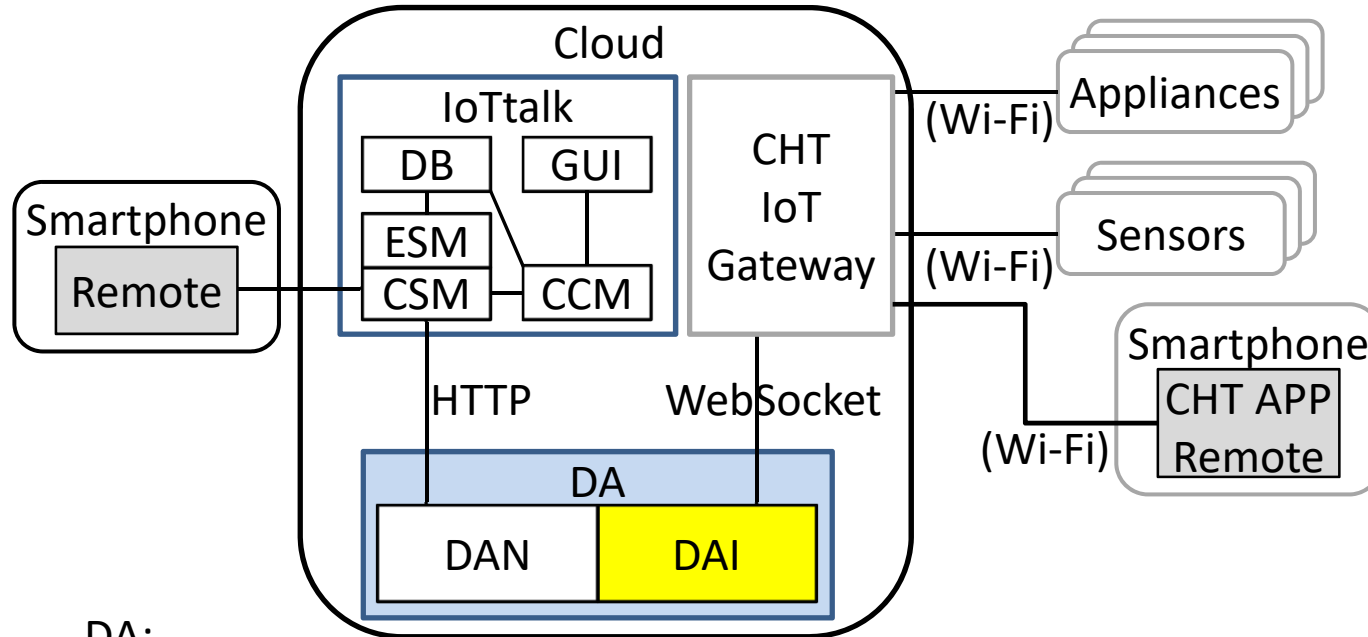


Example: The Smart Home Solution by CHT

- Chunghwa Telecom (CHT) provides a smart home solution through a USB dongle and an IoT gateway.
- Each appliance is plugged in the USB Wi-Fi dongle for connecting to the IoT gateway.
- A user can remote an appliance by its remote APP in the smartphone.



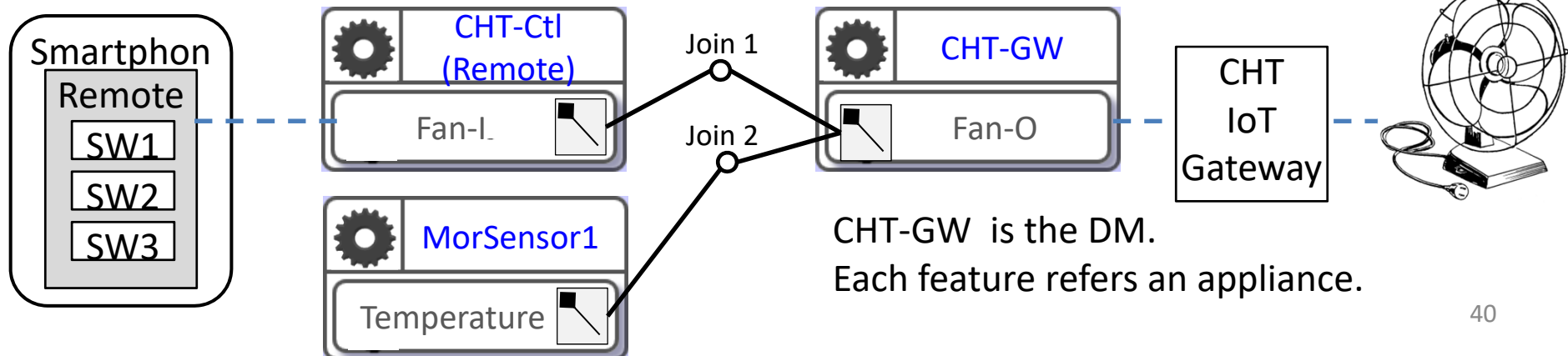
CHT Smart Home with IoTtalk



DA:

1. Register/Deregister for appliances/sensors according to **notifications**
2. Pull **commands** from the IoTtalk server to CHT home server
3. Receive **sensor data** then Push them to the IoTtalk server

For example:



You can try IoTtalk at:

<https://test.iottalk.tw>

Any question?