A Smart Home with 2 Gateways
Connecting Sensors and Actuators to the Cloud

NCTU introduction to IoT
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Objective

A Smart Home System with 2 Raspberry Pi as gateways, connecting 3 types of IoT sensors, 3 types of actuators and MediaTek Cloud Sandbox server (MCS).

Section 1：Temperature/Humidity too high → Turn on the fan.

Section 2：Brightness in the room → Luminance of the LED.

Section 3：Intruder detected → Send a Line Notify + Play the buzzer.
System Specification – Topology

[Diagram showing the interconnection of Raspberry Pi nodes with various sensors and actuators.]

1. Raspberry Pi
   - API
   - DHT sensor
   - Light sensor
   - Fan
   - Relay module
   - GPIO17
   - GPIO22
   - GPIO25
   - GPIO26
   - LED

2. Raspberry Pi
   - API
   - DHT sensor
   - Light sensor

3. Cloud Sandbox
   - API

Connections:
- DHT sensor
- Light sensor
- Fan
- Relay module
- LED
- GPIO17
- GPIO22
- GPIO25
- GPIO26
- PIR sensor
- Buzzer
- LINE Notify

[Images of sensors and actuators are depicted within the diagram.]
Measure temp/humidity by DHT sensors every 30 s.

Raspberry Pi 1 and 2 send the data to MCS.
Raspberry Pi 1

retrieves the data of Raspberry Pi 2,

calculates the average,

sends back to MCS.
(Avg Temp > 27°C) or (Avg Humidity > 80%),
MCS sets on the Fancontrol data channel.
Raspberry Pi 1 receives the signal,
turns on the fan through relay module.
Click on the LightAutomation button on MCS to start.

Measure light level by light sensors every 30 s. Raspberry Pi 1 and 2 send the data to MCS.
System Specification – Section 2

Raspberry Pi 1 retrieves the data of Raspberry Pi 2, chooses the darker one’s value, and modulates the luminance of LED.
This alarm system keeps running.

Detect an intruder by PIR sensor.
If detected, Raspberry Pi 1 plays the buzzer to give a warning and sends a line notify to the owner immediately.
## System Components

### Hardware

<table>
<thead>
<tr>
<th>Component Name</th>
<th>Model</th>
<th>Functionality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raspberry Pi 4</td>
<td>Model B, 1 GB RAM</td>
<td>Gateway</td>
</tr>
<tr>
<td>LED</td>
<td>Red</td>
<td>Emit visible light</td>
</tr>
<tr>
<td>Light sensor (Light dependent resistor)</td>
<td>GL55</td>
<td>Measure the light level</td>
</tr>
<tr>
<td>Capacitor</td>
<td>1 μF, 50 V</td>
<td>Construct RC circuits</td>
</tr>
<tr>
<td>Resistor</td>
<td>1 kΩ</td>
<td>Adjust the voltage</td>
</tr>
<tr>
<td>PIR sensor</td>
<td>HW–416–B</td>
<td>Detect the motion</td>
</tr>
<tr>
<td>Buzzer</td>
<td>G-S&amp;S</td>
<td>Alarm the intruder</td>
</tr>
<tr>
<td>DHT sensor</td>
<td>AM2302</td>
<td>Measure temp/humidity</td>
</tr>
<tr>
<td>Fan</td>
<td>Raspberry Pi cooling fan</td>
<td>Cool down the room</td>
</tr>
<tr>
<td>Relay module</td>
<td>4–channel 5V</td>
<td>Adjust the voltage</td>
</tr>
<tr>
<td>Bread board</td>
<td>EIC–1104</td>
<td>Build electronic circuits</td>
</tr>
<tr>
<td>Dupont wire</td>
<td>Male to Male/Male to Female/Female to Female</td>
<td>Construct circuits</td>
</tr>
</tbody>
</table>
### System Components

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<thead>
<tr>
<th>Component Name</th>
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<tbody>
<tr>
<td>Python script</td>
<td>3.7.6</td>
<td>Instructions to control the system</td>
</tr>
<tr>
<td>MCS</td>
<td>Data channel – Controller, Display, Function</td>
<td>Store the data, User interface to control the system, Make the conditional judgment</td>
</tr>
</tbody>
</table>
MCS Dashboard

Temperature1: 0.0

Temperature2: 0.0

TempAvgtoFanControl1: 0

Humidity1: 0

Humidity2: 0

HumidityAvgtoFanControl2: 0

Fancontrol1: 0

Fancontrol2: 0

LightAutomation: N/A

DarkLevel1: 0

DarkLevel2: N/A
MCS Restriction

• Data channel – Function cannot use the data of other data channels to compute. → solution: Raspberry Pi 1 retrieves the data, does the computation like avg of temp/humidity.

• “Bad Access” if query too often → solution: Raspberry Pi sends the measured data all at once every 30 seconds. Stagger the time that Raspberry Pi 1 and Raspberry Pi 2 upload the data. For example, Raspberry Pi 2 runs first and reiterates after Raspberry Pi 1 finishes.
Implementation Photo

Raspberry Pi uses as the power supply of relay module

Raspberry Pi 1

Raspberry Pi 2
Deliverables

1. Integrated hardware and software components
2. Programs with flowchart to run on Raspberry Pi
3. Programs with flowchart to run on MCS
4. Report: 8-16 pages with
   (1) project title and author name, (2) objective, (3) system components,
   (4) system specification, (5) system design with flowcharts, (6) demonstration,
   (7) references
Demo Video

• Intruder Alarm

https://drive.google.com/file/d/13JZ9pcYjTFxTHVWuq59qKli4FQmHE9H5/view?usp=sharing

• Fan

https://drive.google.com/file/d/1yntownm2vL5BGeqvI8BQLCxciTwh4NUN/view?usp=sharing

• Light Automation

https://drive.google.com/file/d/1BiadGSh8Q6g5M0EwRtujHp1uaamTyr6w/view?usp=sharing
Thank you!