Ubiquitous Computing - Lab 3: Node-RED

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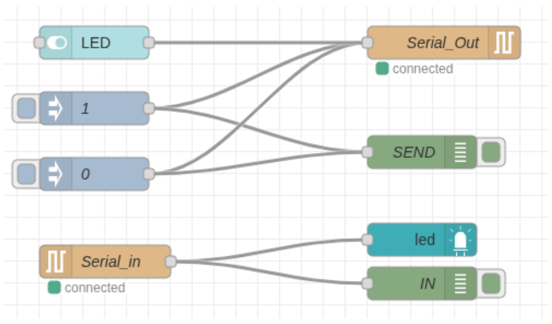
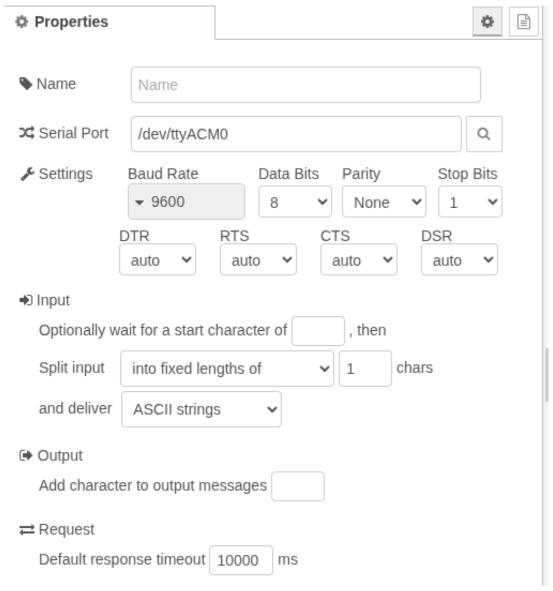
1. Exercise 1

The Arduino code was not difficult to write but I had to think to organize the read and write functionnalities.

```
  #include <WiFiNINA.h>

#define BUTTON_PIN 2 // see circuit in subject.pdf

int lastButtonState = LOW; // start with led off

void setup() {
    Serial.begin(9600);
    // prepare pins to use
    pinMode(LEDB, OUTPUT);
    pinMode(BUTTON_PIN, INPUT);
}

void loop() {

    // read what Node-RED sent
    if (Serial.available() > 0) {
        switch (Serial.read()) {
            case '1': // turn on light
                digitalWrite(LEDB, HIGH);
                break;
            case '0': // turn off
                digitalWrite(LEDB, LOW);
                break;
        }
    }

    // write to Node-RED
    int currentButtonState = digitalRead(BUTTON_PIN);
    if (currentButtonState != lastButtonState) { // only send when update
        lastButtonState = currentButtonState;
        Serial.print(currentButtonState == HIGH ? '1' : '0');
    }

    delay(100); // wait to avoid overloading Node-RED
}
```

The flow was trickier to craft. In particular, the configuration of the serial port. Indeed, the Arduino sketch was way too fast for the Node-RED flow to follow. Instead of reading the numbers one by one, it read large chunks of `000...0` and `111...1`. To solve this problem, I added a delay of 100ms and a “toggle-only output” in the Arduino sketch. I also configured the serial port to split the input in chunks of 1 character.




Properties

Name: Name

Serial Port: /dev/ttyACM0

Settings: Baud Rate 9600, Data Bits 8, Parity None, Stop Bits 1

DTR auto, RTS auto, CTS auto, DSR auto

Input

Optionally wait for a start character of , then

Split input into fixed lengths of 1 chars

and deliver ASCII strings

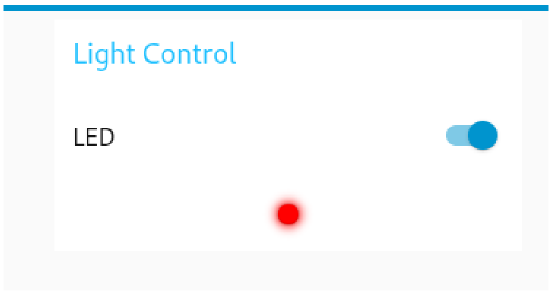
Output

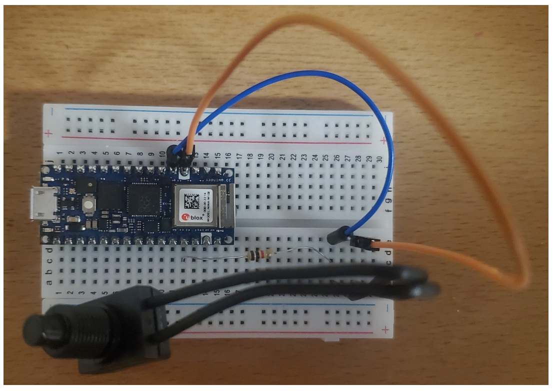
Add character to output messages

Request

Default response timeout 10000 ms

I also configured the led node to map 1 (resp. 0) to the red (resp. gray) color, so that it looks turned on when the arduino button is pressed and turned off otherwise. The switch node was configured accordingly with string “1” when “On Payload” and “0” when “Off Payload”





Another issue I ran into was a set of GND pins that weren’t working. I eventually discovered that using my fingers worked as a temporary ground, but only after spending time testing each component to figure out which one was actually defective.

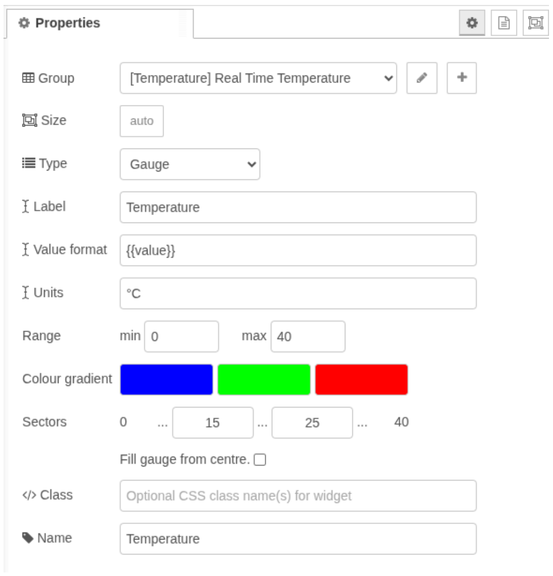
2. Exercise 2

This exercise was pretty straightforward since a similar Arduino sketch was required for the first lab session. I just changed the code for the captor to read the temperature as a float and see more subtle fluctuations on the dashboard’s chart.

```
 #include <Arduino_LSM6DSOX.h>

void setup() {
    Serial.begin(9600);
    if (!IMU.begin()) {
        Serial.println("Failed to init IMU!");
        while (1)
            ;
    }
}
```

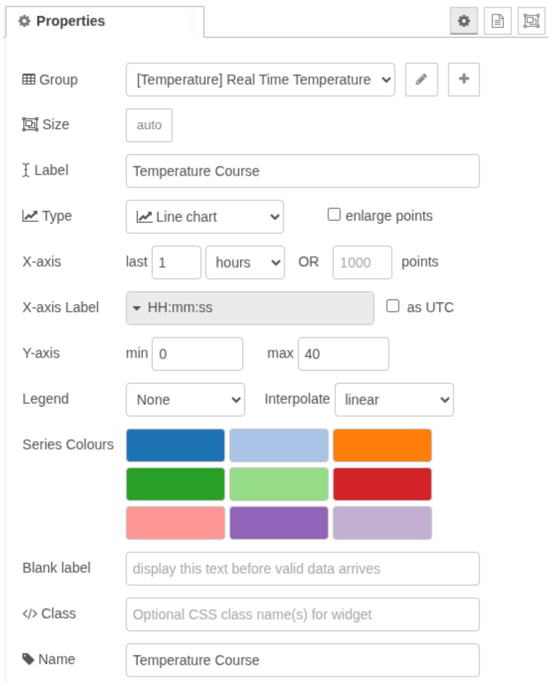
```
void loop() {
    float tempC; // use a float for better precision

    // read temperature and write to serial port
    if (IMU.temperatureAvailable()) {
        IMU.readTemperatureFloat(tempC);
        Serial.println(tempC);
    }
    delay(100);
}
```

The gauge node is configured as instructed in the subject with three different ranges.



Properties

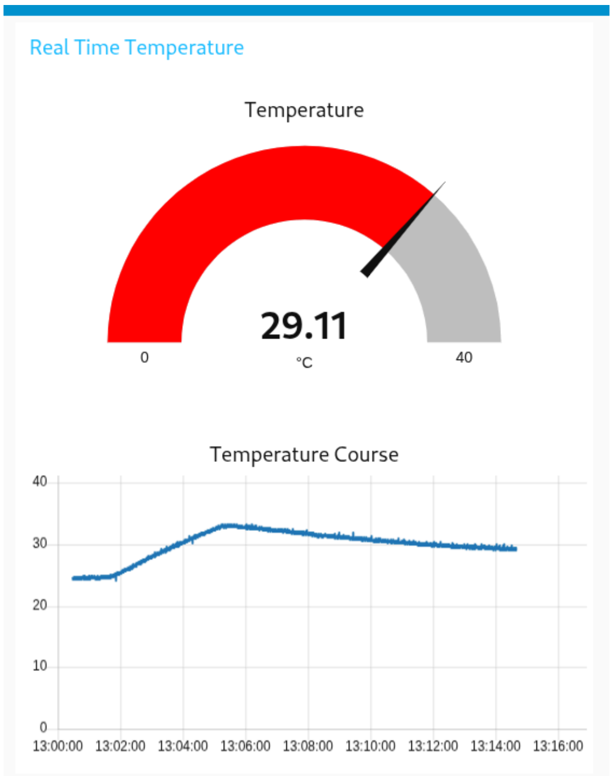
Group	[Temperature] Real Time Temperature
Size	auto
Type	Gauge
Label	Temperature
Value format	{{value}}
Units	°C
Range	min 0 max 40
Colour gradient	🟦 🟩 🟥
Sectors	0 ... 15 ... 25 ... 40
	Fill gauge from centre. ☐
Class	Optional CSS class name(s) for widget
Name	Temperature



Properties

Group	[Temperature] Real Time Temperature
Size	auto
Label	Temperature Course
Type	Line chart ☐ enlarge points
X-axis	last 1 hours OR 1000 points
X-axis Label	HH:mm:ss ☐ as UTC
Y-axis	min 0 max 40
Legend	None Interpolate linear
Series Colours	🟦 🟦 🟧 🟩 🟩 🟥 🟥 🟪 🟪
Blank label	display this text before valid data arrives
Class	Optional CSS class name(s) for widget
Name	Temperature Course

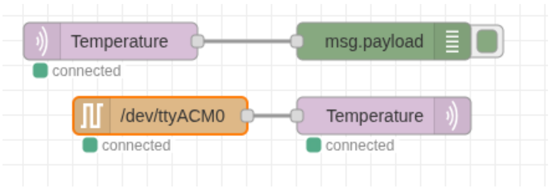
Below is the final dashboard after a few minutes of heating then cooling the Arduino board to display changes.

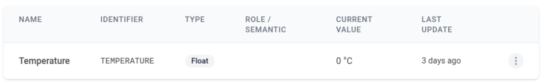


3. Exercise 3

This exercise's goal is to use a third element in the information chain: cloud software. The data is collected by the Arduino board's sensor as in the previous exercise (same code and serial in node), It is then sent to the MQTT broker through a dedicated node. Another dedicated node reads the data from the MQTT broker and outputs it to the debug console.

All nodes are on the same Node-RED computer, but the flow is seperated in two distinct components that don't directly communicate. This means they could be running on two different instances anywhere in the world. For instance one would be in a patient's home and the other at a hospital or a data collection center.

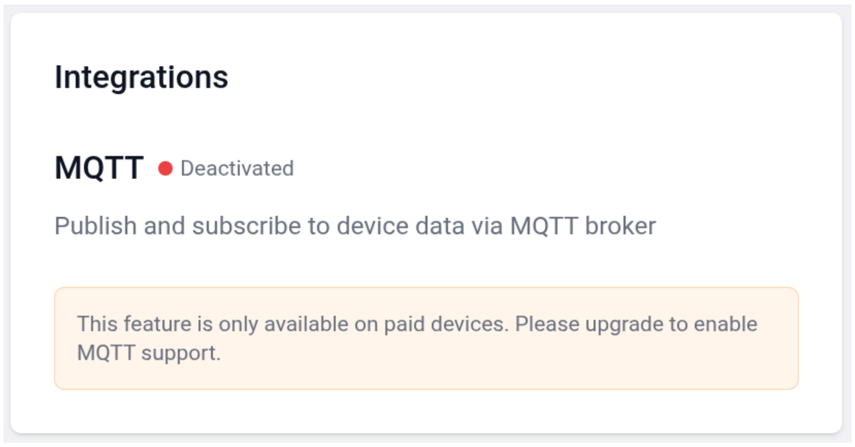




NAME	IDENTIFIER	TYPE	ROLE / SEMANTIC	CURRENT VALUE	LAST UPDATE
Temperature	TEMPERATURE	Float		0 °C	3 days ago

The next step was to create an online dashboard that could be accessed easier than the Node-RED one from the other exercises. For that, we use Datacake with integrated MQTT to fetch data from the HiveMQ cluster.

At first, I had an issue with the Datacake part of this exercise. Indeed, I reached a paywall when trying to activate the MQTT integration feature.


Integrations

MQTT ● Deactivated

Publish and subscribe to device data via MQTT broker

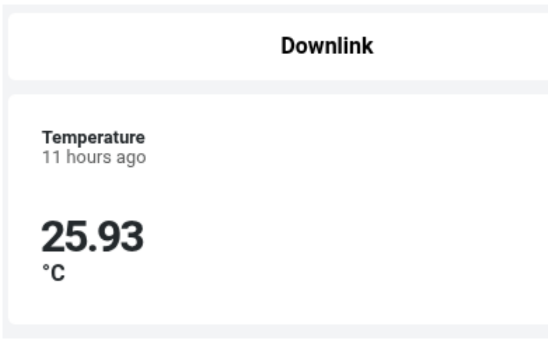
This feature is only available on paid devices. Please upgrade to enable MQTT support.

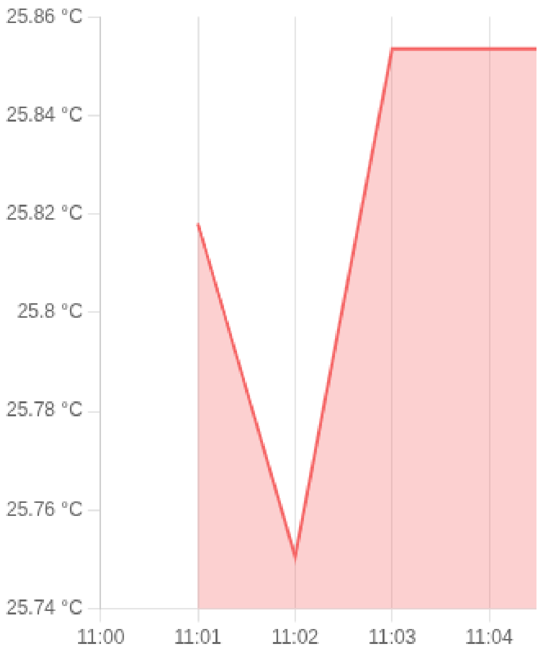
But another page allowed me to configure the integration for free, as expected in the tutorial. An encoder and decoder are required for this part. Here are the functions used adapted from the provided dummies.

```
 function Encoder(device, measurements) {
   // Get Device Information
   var device = device.id;
   var serial = device.serial_number;
   var name = device.name;

   // Create JSON Payload for Publish
   var payload = {
       message: "Hello World!",
       info: "Sent from Datacake IoT Platform",
       device: device,
       name: name,
       serial: serial,
       temperature: 23.45,
       status: true,
   };

   // Return Topic and Payload
   return {
       topic: "Temperature", // define topic
       payload: JSON.stringify(payload), // encode to string
   };
}
```

```
 function Decoder(topic, payload) {
   return [
       {
           // Datacake device serial number
           device: "31663110-f18f-4ac8-8af3-804a97e33637",
           // field name in db
           field: "TEMPERATURE",
           value: JSON.parse(payload),
           timestamp: Date.now(),
       },
    ];
}
```

In the end, I created a Downlink widget on the dashboard and connected it to the previous configurated component. The dashboard also includes a history of the stored temperature values.





My Arduino script made a hundred readings per second, which quickly overloaded the service, exceed the datapoint quota and blocking the MQTT server.