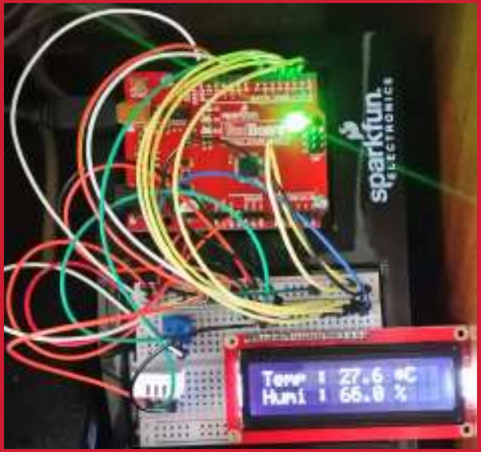
Arduino-IOT

[wk11]

Arduino + nods.js Data visualization III



Visualization of Signals using Arduino, Node.js & Storing Signals in MongoDB & Mining Data using Python

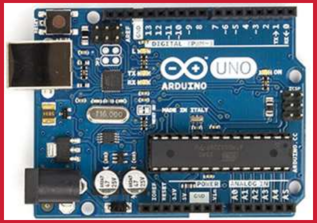
Comsi, INJE University

2nd semester, 2019

Email : chaos21c@gmail.com

My ID

ID	성명
AA01	김관용
AA02	백동진
AA03	김도훈
AA04	김희찬
AA05	류재현
AA06	문민규
AA07	박진석
AA08	이승협
AA09	표혜성
AA10	김다영
AA11	성소진
AA12	김해인
AA13	신송주
AA14	윤지훈



[Review]

- [wk10]
  - RT Data Visualization with node.js
  - Usage of gauge.js
  - Complete your plotly-node project
  - Upload folder: AAnn_Rpt08

wk10 : Practice : AAnn_Rpt08

◆ [Target of this week]

- Complete your works
- Save your outcomes and upload outputs in github

제출폴더명 : **AAnn_Rpt08**

- 압축할 파일들

① **AAnn_DS_30timestamps.png**

② **AAnn_DS_multiple_axis.png**

③ **AAnn_cds_gauge.png**

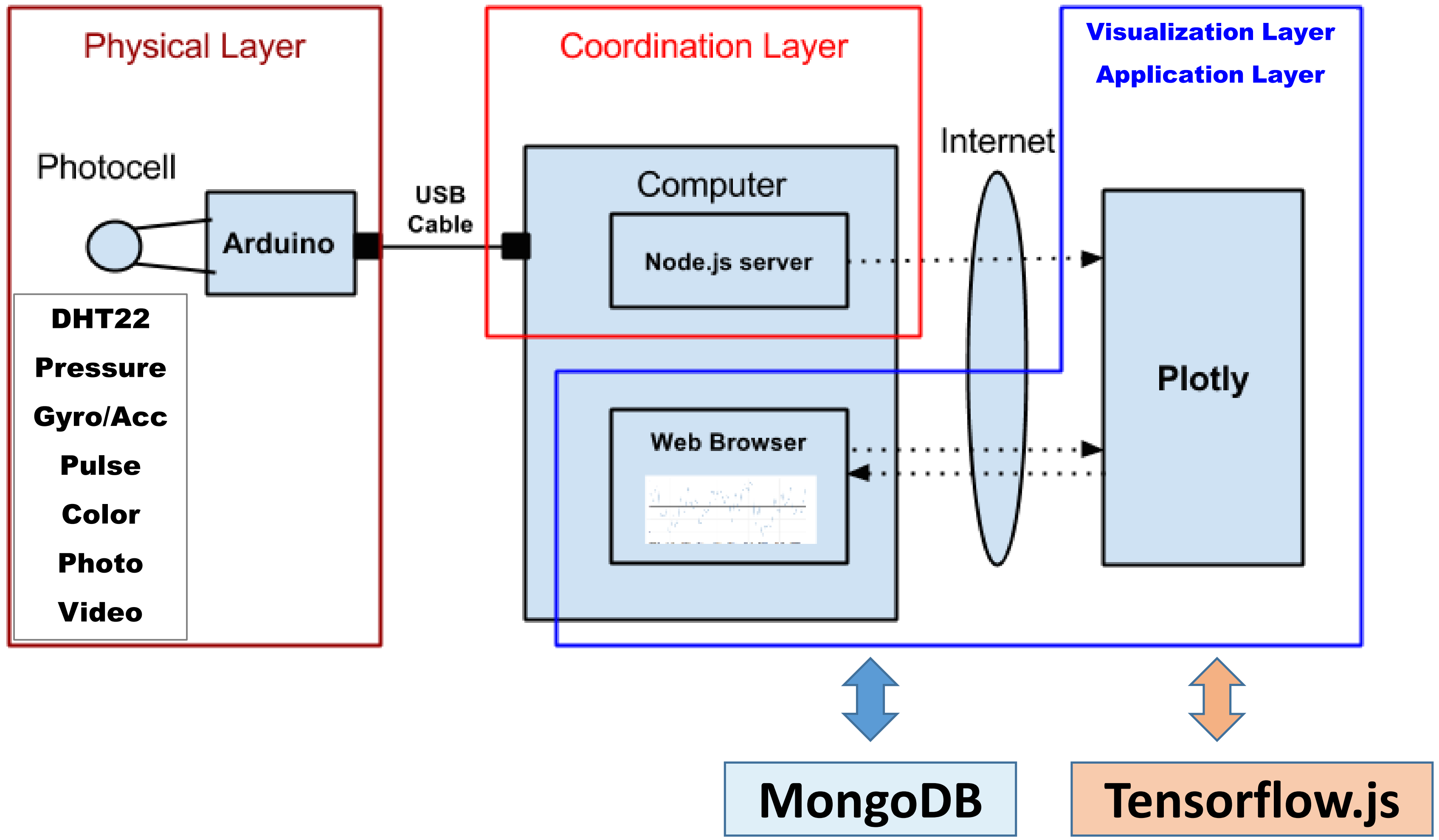
④ **AAnn_cds_change.png**

⑤ **All *.ino**

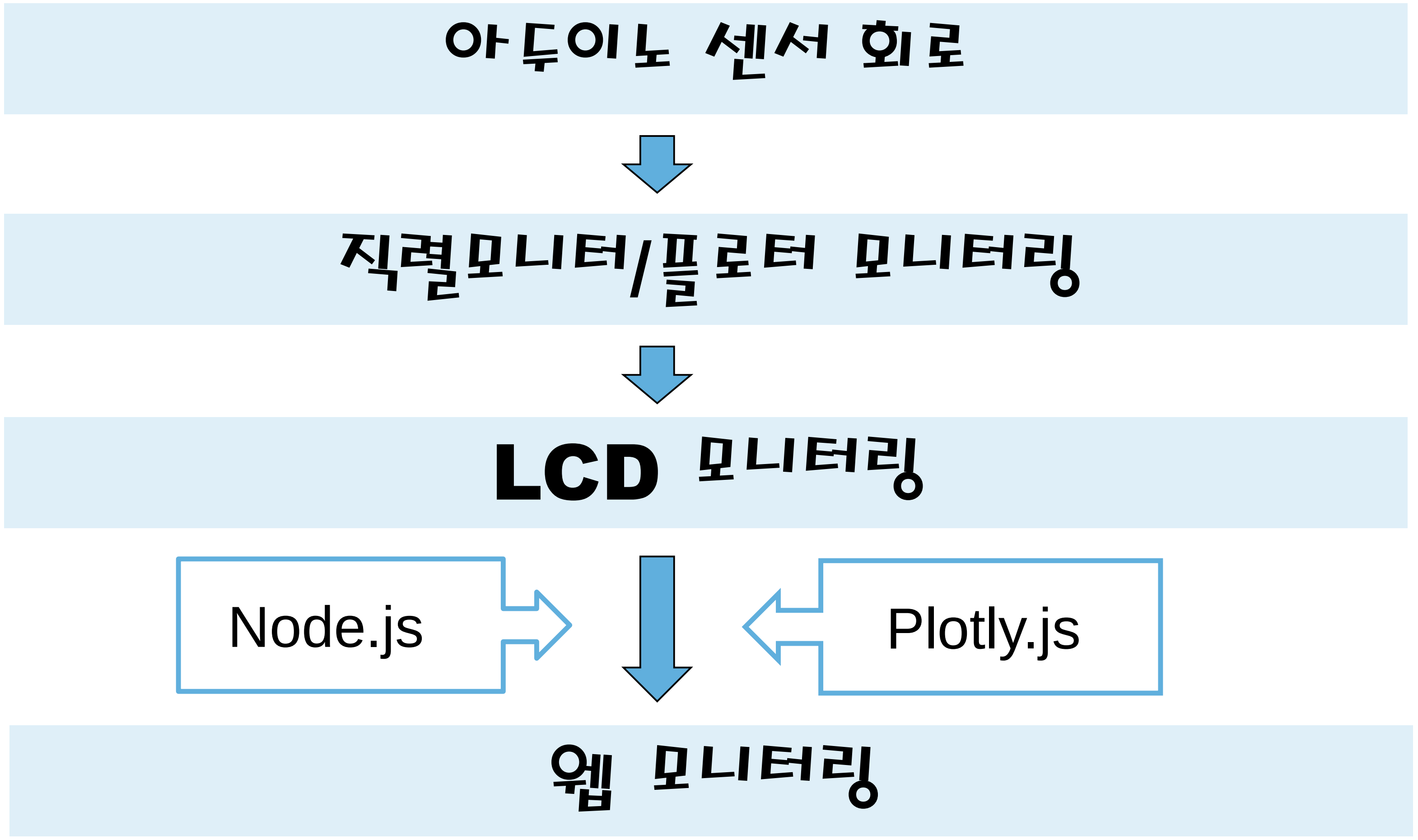
⑥ **All *.js**

⑦ **All *.html**

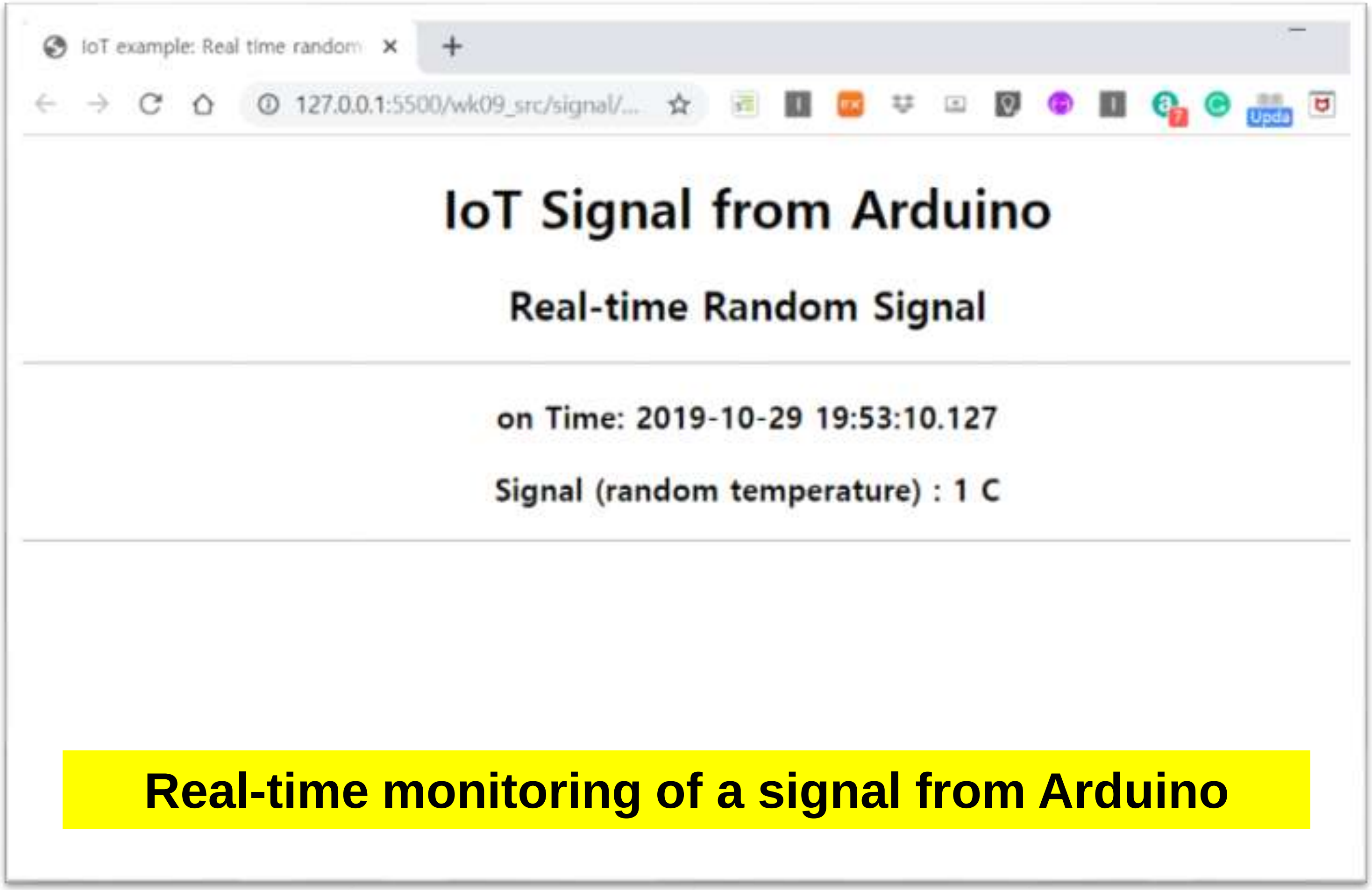
Layout [H S C]


Physical Layer
Coordination Layer
Visualization Layer
Application Layer
Photocell
Arduino
USB Cable
Computer
Node.js server
Internet
Plotly
Web Browser
DHT22
Pressure
Gyro/Acc
Pulse
Color
Photo
Video
MongoDB
Tensorflow.js

A5.1 Introduction to data visualization



Arduino data on network socket



IoT example: Real time random

127.0.0.1:5500/wk09_src/signal/...

IoT Signal from Arduino

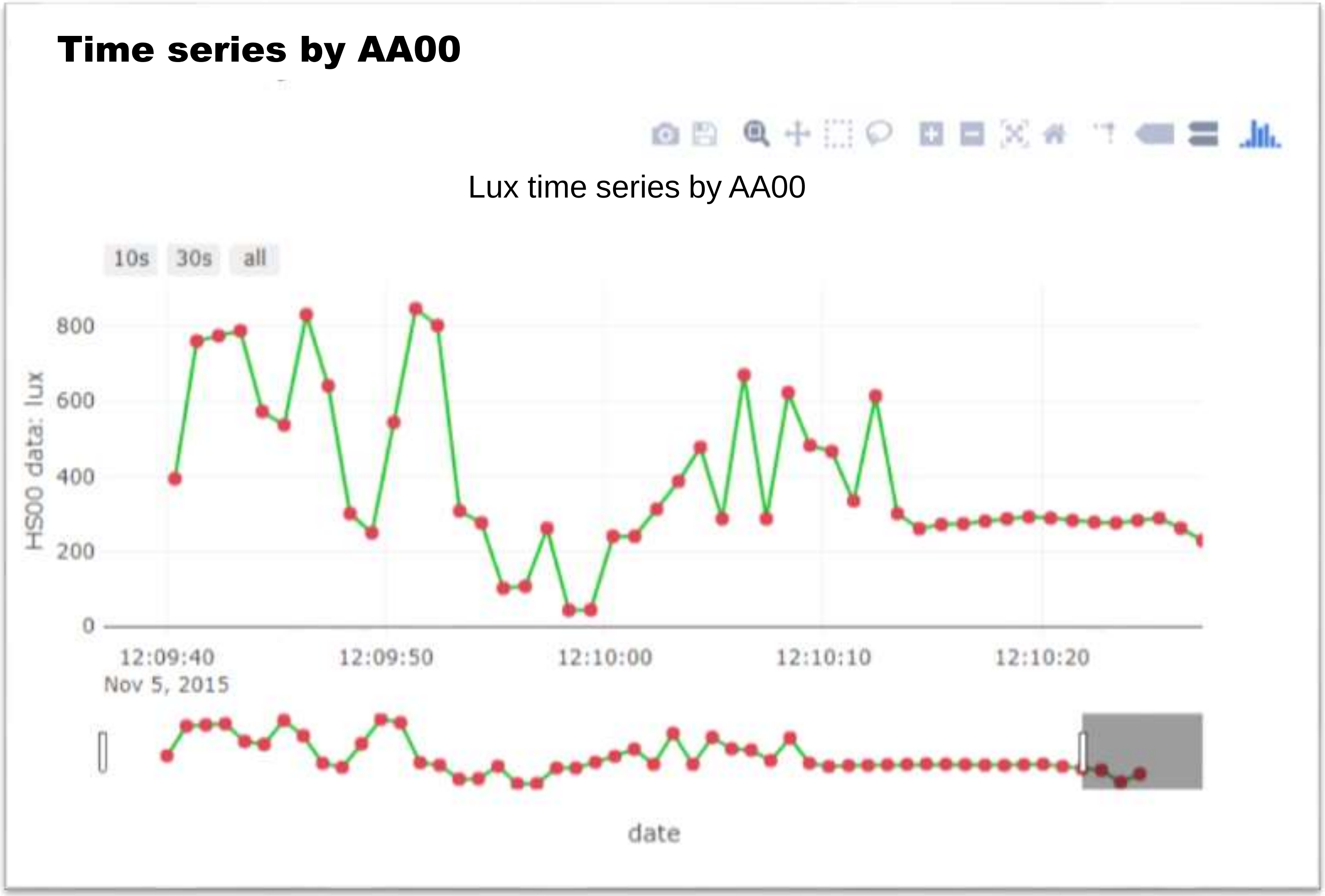
Real-time Random Signal

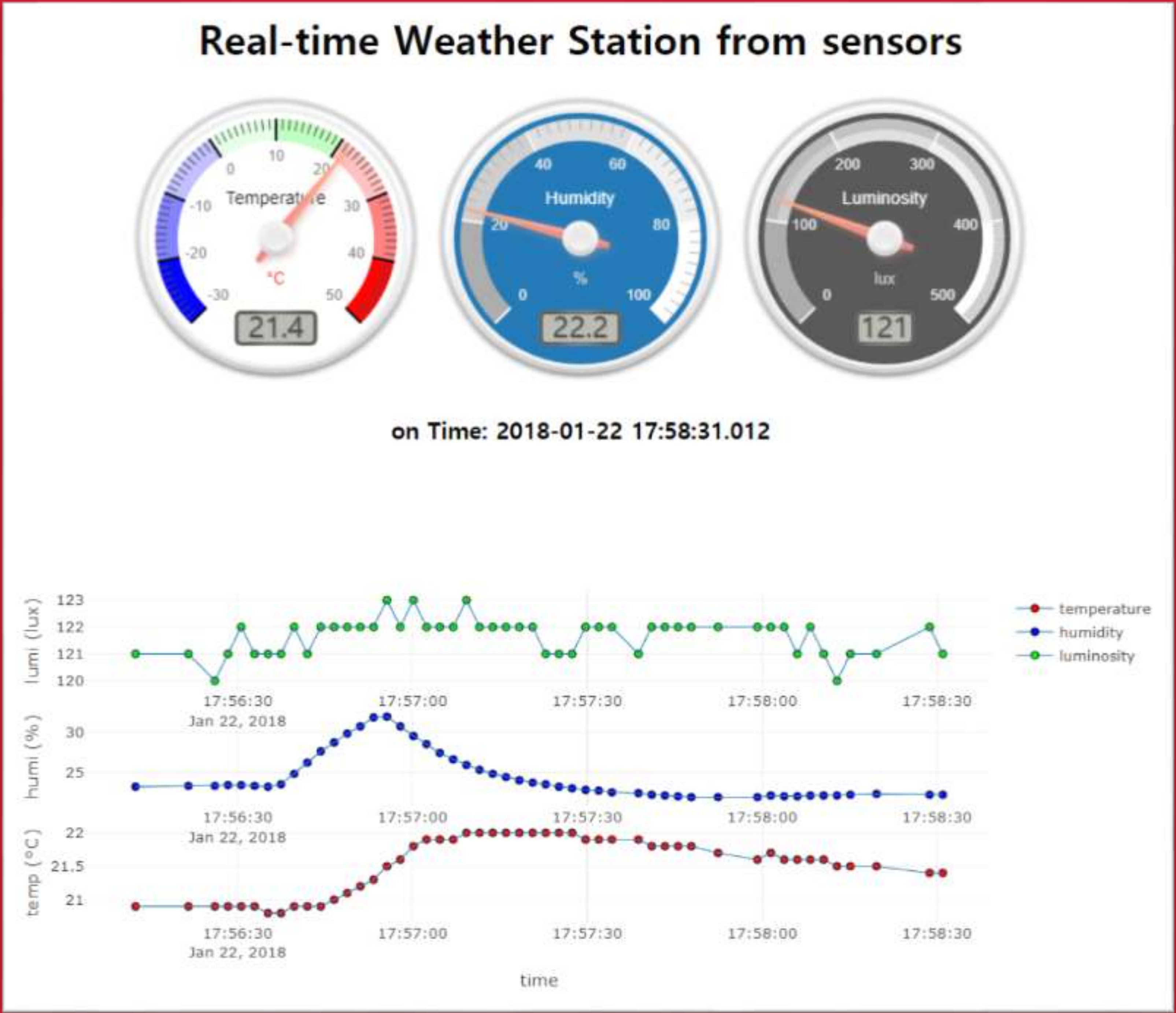
on Time: 2019-10-29 19:53:10.127

Signal (random temperature) : 1 C

Real-time monitoring of a signal from Arduino

Arduino data + plotly

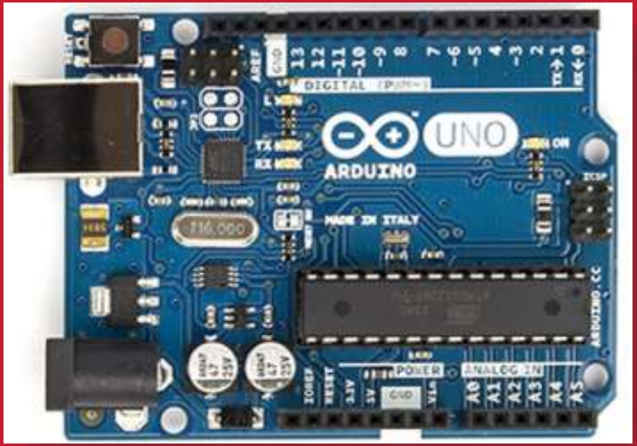




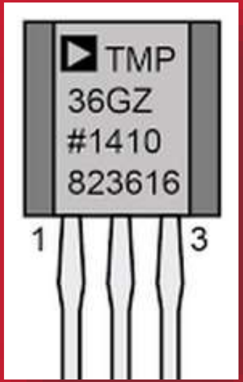
Real-time Weather Station from sensors

on Time: 2018-01-22 17:58:31.012

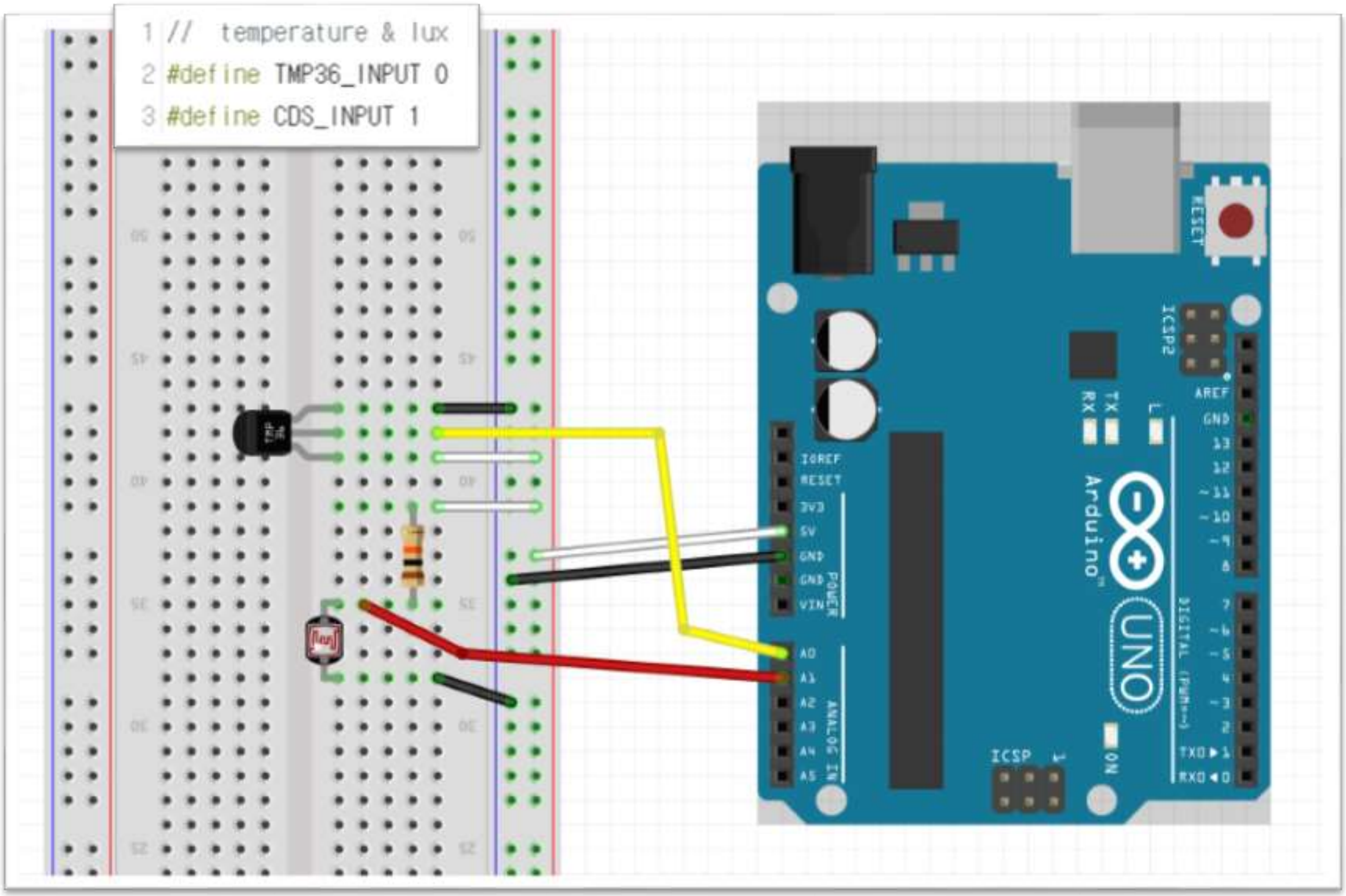
Multiple sensors



CdS + TMP36 + plotly.js Node project

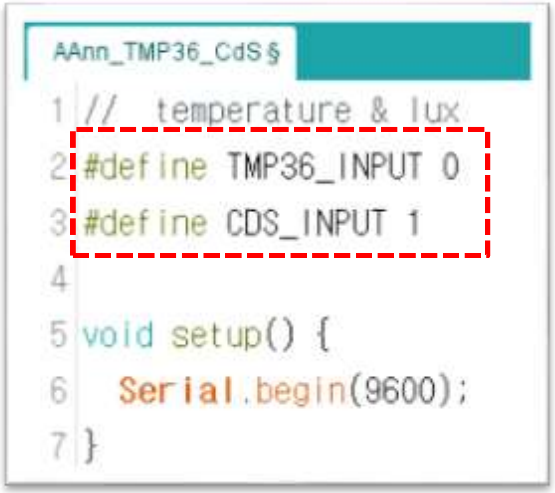


A4.3.1 TMP36 + CdS : circuit



```
// temperature & lux
#define TMP36_INPUT 0
#define CDS_INPUT 1
```

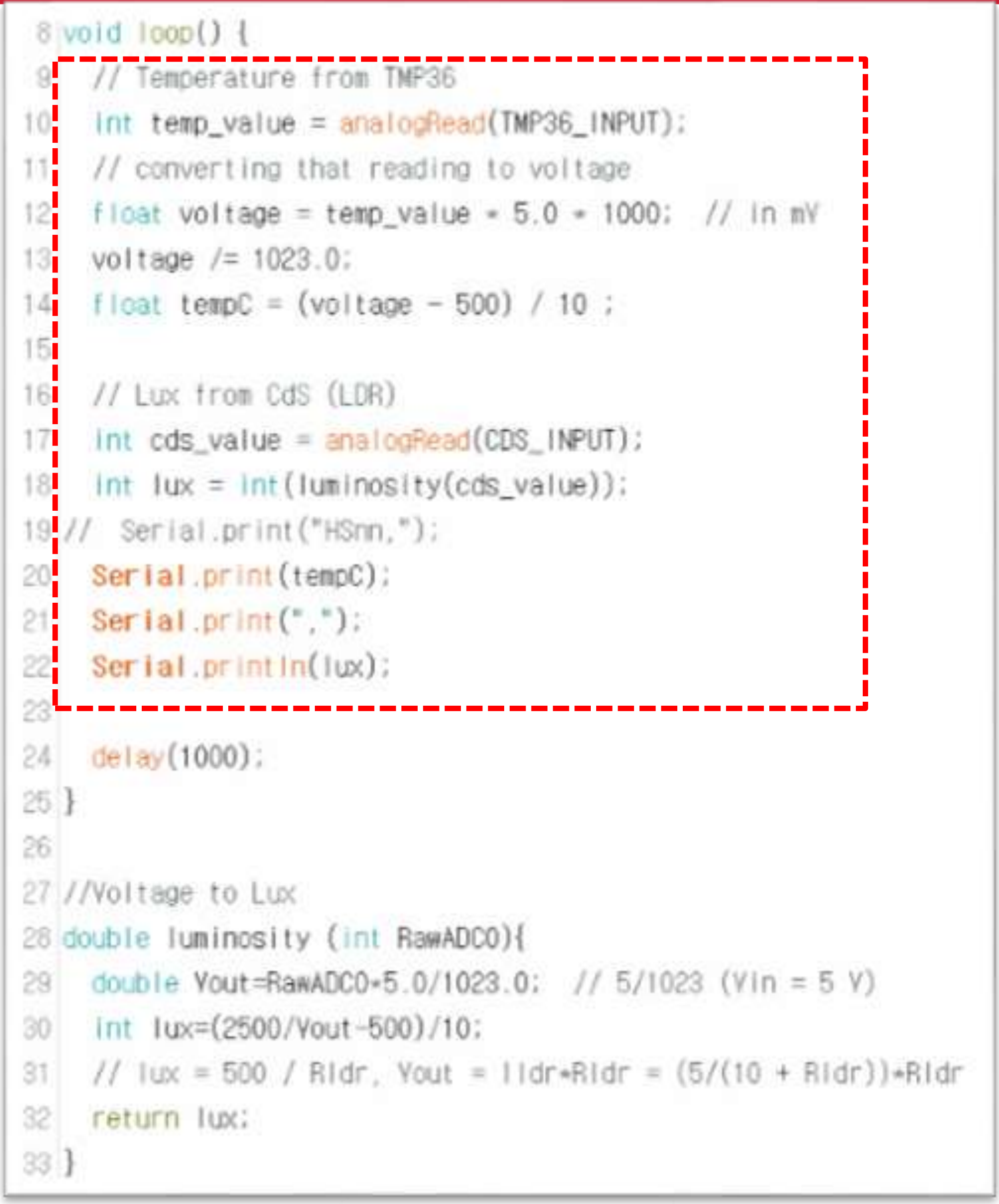
A4.3.2 TMP36 + CdS : code



AAnn_TMP36_CdS §

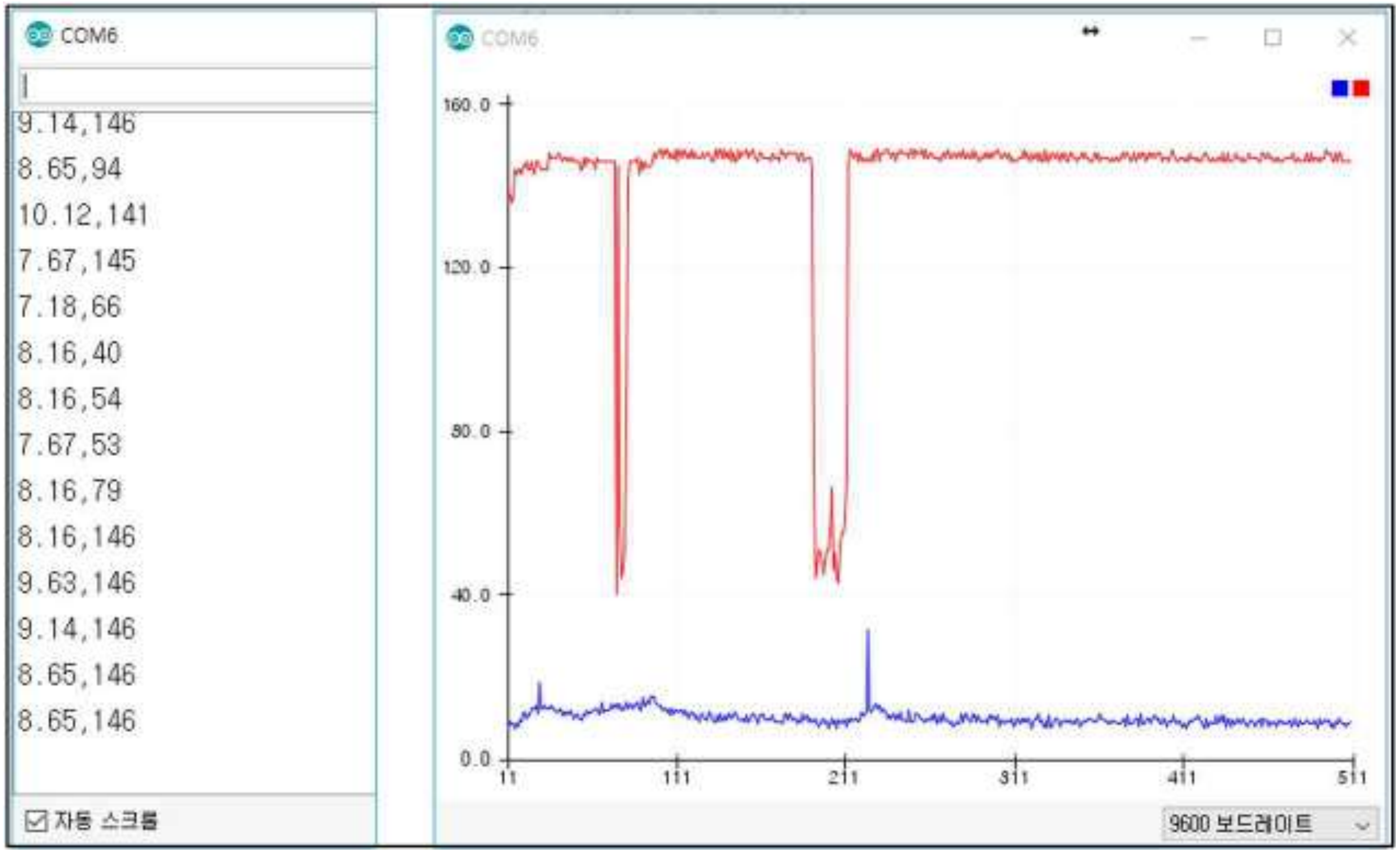
```
//  temperature & lux
#define TMP36_INPUT 0
#define CDS_INPUT 1

void setup() {
  Serial.begin(9600);
}
```

AAnn_tmp36_cds.ino



```
void loop() {
  // Temperature from TMP36
  int temp_value = analogRead(TMP36_INPUT);
  // converting that reading to voltage
  float voltage = temp_value * 5.0 * 1000;  // in mV
  voltage /= 1023.0;
  float tempC = (voltage - 500) / 10 ;

  // Lux from CdS (LDR)
  int cds_value = analogRead(CDS_INPUT);
  int lux = int(luminosity(cds_value));
//  Serial.print("HSnn,");
  Serial.print(tempC);
  Serial.print(",");
  Serial.println(lux);

  delay(1000);
}

//Voltage to Lux
double luminosity (int RawADC0){
  double Vout=RawADC0*5.0/1023.0;  // 5/1023 (Vin = 5 V)
  int lux=(2500/Vout-500)/10;
  // lux = 500 / Rldr, Vout = Ildr*Rldr = (5/(10 + Rldr))*Rldr
  return lux;
}
```

A4.3.2 TMP36 + CdS : result



```
9.14,146
8.65,94
10.12,141
7.67,145
7.18,66
8.16,40
8.16,54
7.67,53
8.16,79
8.16,146
9.63,146
9.14,146
8.65,146
8.65,146
```

A4.5.1 CdS + TMP36 + Node project

1. Make cds_tmp36 node project
   - ➢ md cds_tmp36 in iot folder
   - ➢ cd cds_tmp36
2. Go to cds_tmp36 subfolder
   - ➢ npm init

"main": "cds_tmp36_node.js"
"author": “aann"

name : cds_tmp36

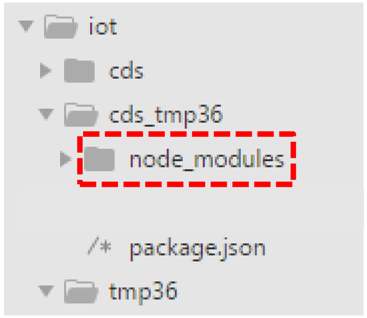
description : cds-tmp36-node project

entry point : cds_tmp36_node.js

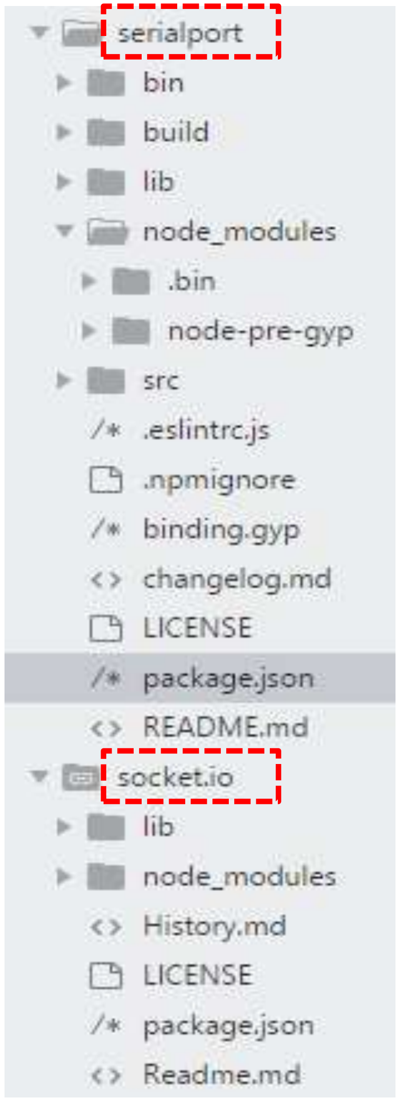
author : hsnn

A4.5.2 CdS + TMP36 + Node project

1. Make cds_tmp36 node project
   - md cds_tmp36 in iot folder
   - cd cds_tmp36
2. Go to cds_tmp36 subfolder
   - npm init
   - **npm install –save serialport@4.0.7**
   - **npm install –save socket.io@1.7.3**



```
▼ iot
  ▶ cds
  ▼ cds_tmp36
    ▶ node_modules
      package.json
  ▼ tmp36
```



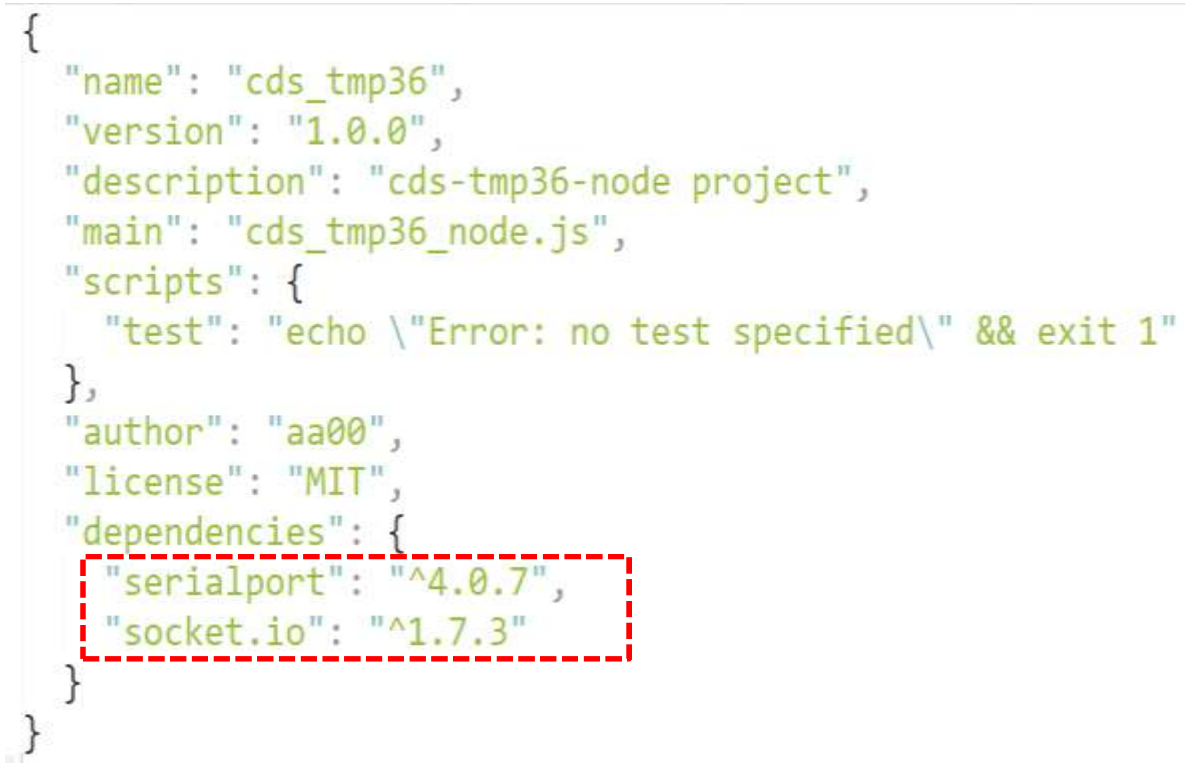
```
▼ serialport
  ▶ bin
  ▶ build
  ▶ lib
  ▼ node_modules
    ▶ .bin
    ▶ node-pre-gyp
  ▶ src
    .eslintrc.js
    .npmignore
    binding.gyp
    changelog.md
    LICENSE
    package.json
    README.md
▼ socket.io
  ▶ lib
  ▶ node_modules
    History.md
    LICENSE
    package.json
    Readme.md
```

You can check version of each module by browing package.json in each module subfolder.

A4.5.3 CdS + TMP36 + Node project

1. **Make cds_tmp36 node project**
   - ➢ **md cds_tmp36**
   - ➢ **cd cds_tmp36**
2. **Go to cds_tmp36 subfolder**
   - ➢ **npm init**
   - ➢ **npm install –save serialport@4.0.7**
   - ➢ **npm install –save socket.io@1.7.3**

package,json

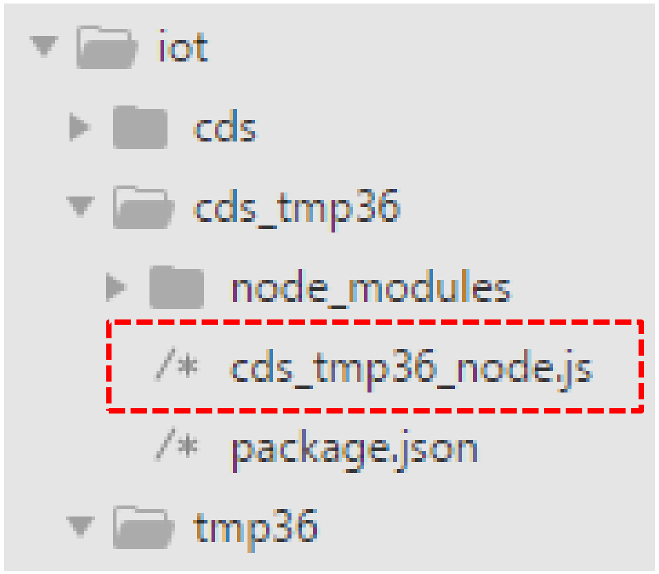


```
{
  "name": "cds_tmp36",
  "version": "1.0.0",
  "description": "cds-tmp36-node project",
  "main": "cds_tmp36_node.js",
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "author": "aa00",
  "license": "MIT",
  "dependencies": {
    "serialport": "^4.0.7",
    "socket.io": "^1.7.3"
  }
}
```

A4.5.4 CdS + TMP36 + Node project

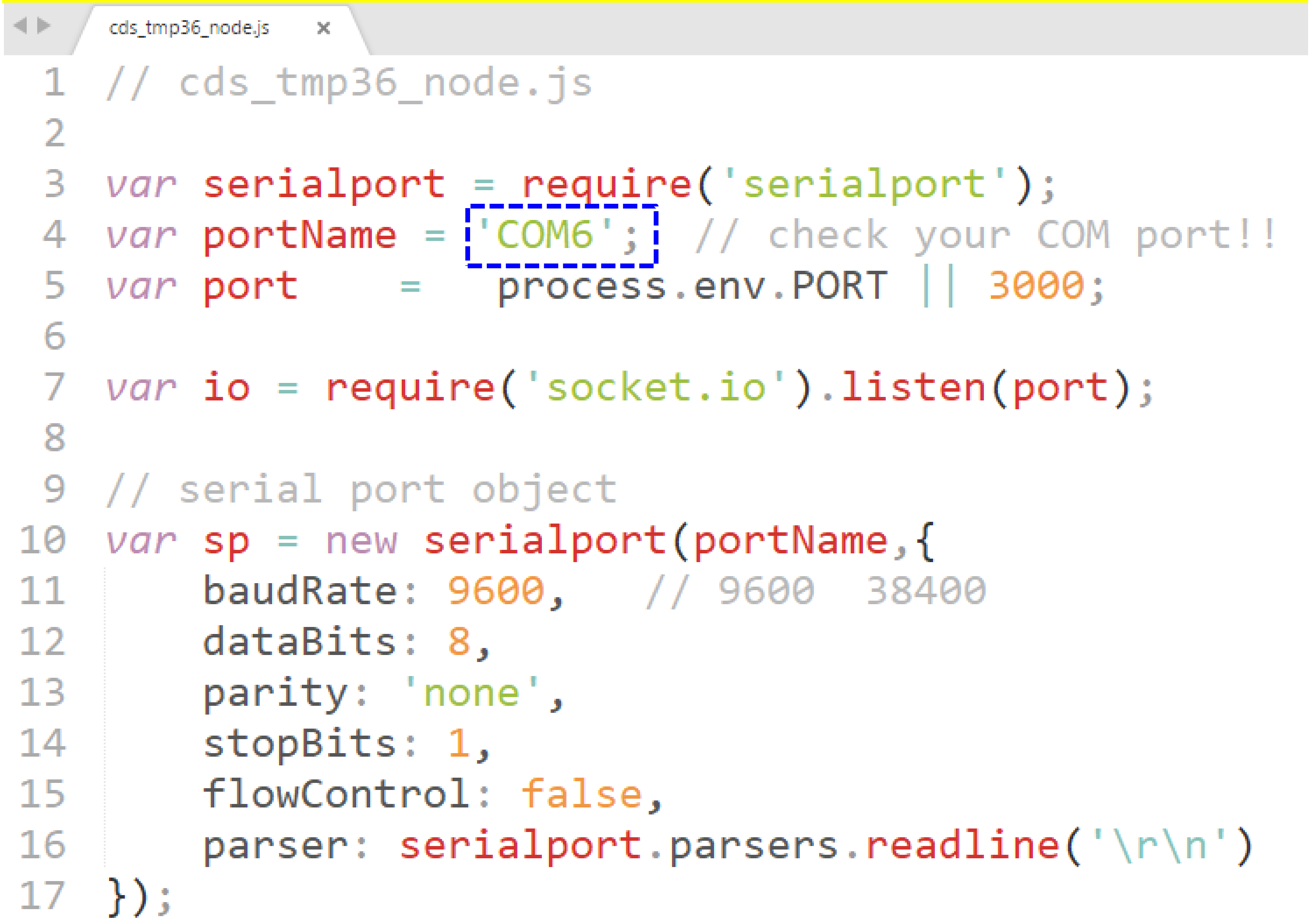
Recycling code:

Save cds_node.js as
cds_tmp36_node.js


```
iot
  cds
  cds_tmp36
    node_modules
    cds_tmp36_node.js
    package.json
  tmp36
```

A4.5.5.1 CdS + TMP36 + Node project : code-1

cds_tmp36_node.js

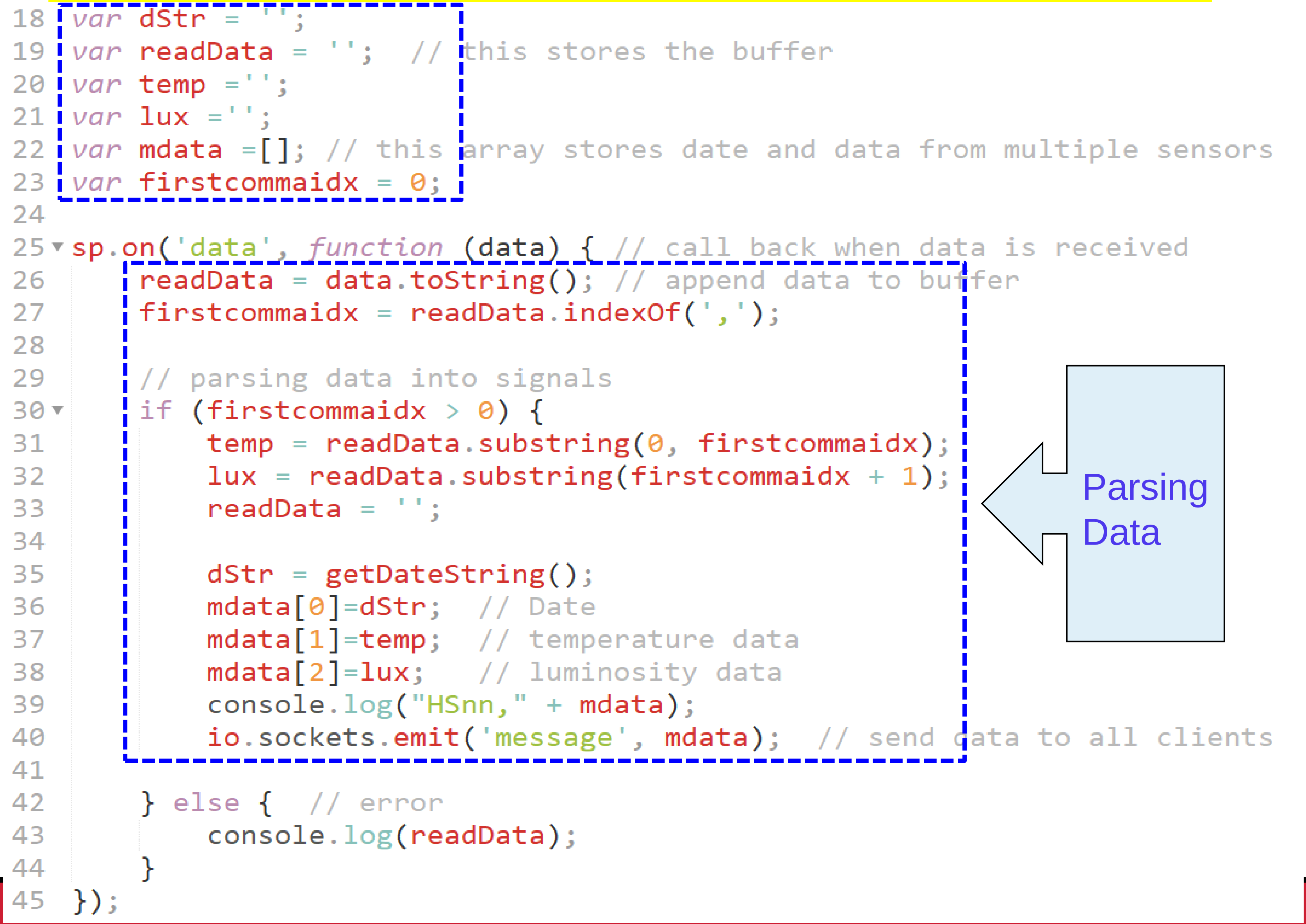


cds_tmp36_node.js ×

```
// cds_tmp36_node.js

var serialport = require('serialport');
var portName = 'COM6';  // check your COM port!!
var port     =    process.env.PORT || 3000;

var io = require('socket.io').listen(port);

// serial port object
var sp = new serialport(portName,{
    baudRate: 9600,   // 9600  38400
    dataBits: 8,
    parity: 'none',
    stopBits: 1,
    flowControl: false,
    parser: serialport.parsers.readline('\r\n')
});
```

A4.5.5.2 CdS + TMP36 + Node project : code-2

cds_tmp36_node.js – parsing data

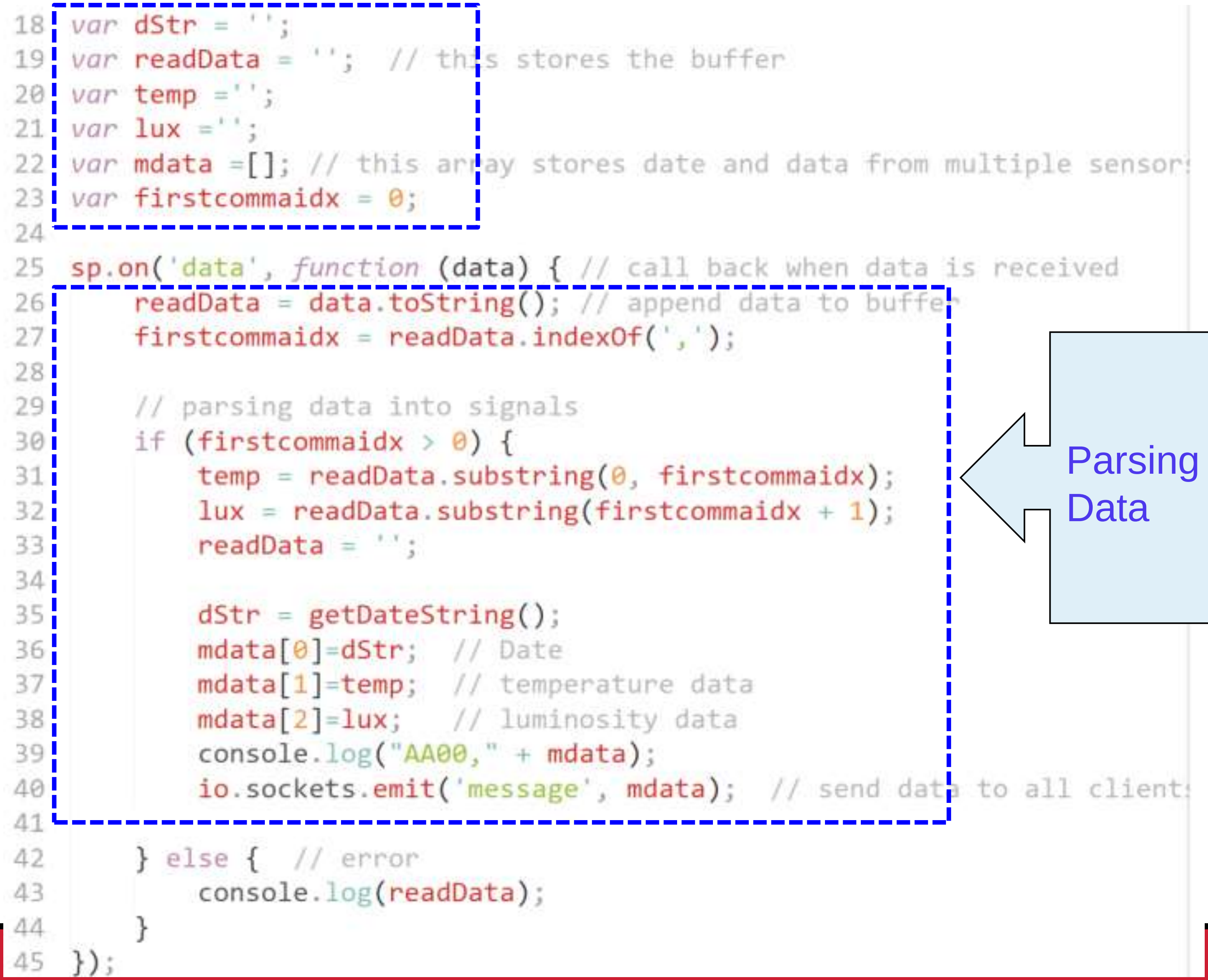


```
var dStr = '';
var readData = '';   // this stores the buffer
var temp ='';
var lux ='';
var mdata =[]; // this array stores date and data from multiple sensors
var firstcommaidx = 0;

sp.on('data', function (data) { // call back when data is received
    readData = data.toString(); // append data to buffer
    firstcommaidx = readData.indexOf(',');

    // parsing data into signals
    if (firstcommaidx > 0) {
        temp = readData.substring(0, firstcommaidx);
        lux = readData.substring(firstcommaidx + 1);
        readData = '';

        dStr = getDateString();
        mdata[0]=dStr;  // Date
        mdata[1]=temp;  // temperature data
        mdata[2]=lux;   // luminosity data
        console.log("HSnn," + mdata);
        io.sockets.emit('message', mdata);  // send data to all clients

    } else {  // error
        console.log(readData);
    }
});
```

Parsing Data

A4.5.5.2 CdS + TMP36 + Node project : code-2

cds_tmp36_node.js – parsing data

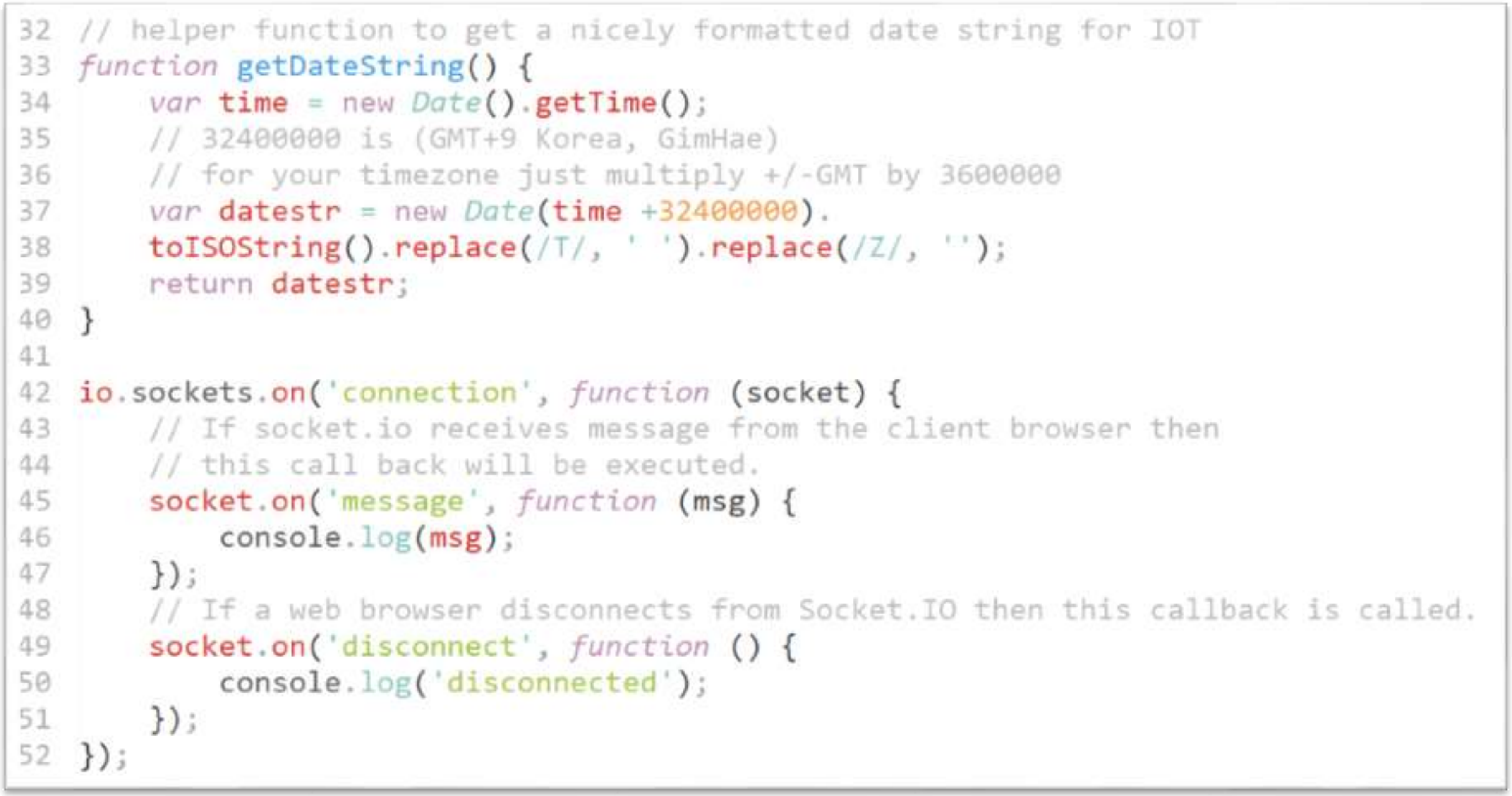


```
var dStr = '';
var readData = '';  // this stores the buffer
var temp ='';
var lux ='';
var mdata =[]; // this array stores date and data from multiple sensor
var firstcommaidx = 0;

sp.on('data', function (data) { // call back when data is received
    readData = data.toString(); // append data to buffer
    firstcommaidx = readData.indexOf(',');

    // parsing data into signals
    if (firstcommaidx > 0) {
        temp = readData.substring(0, firstcommaidx);
        lux = readData.substring(firstcommaidx + 1);
        readData = '';

        dStr = getDateString();
        mdata[0]=dStr;  // Date
        mdata[1]=temp;  // temperature data
        mdata[2]=lux;   // luminosity data
        console.log("AA00," + mdata);
        io.sockets.emit('message', mdata);  // send data to all client
        
    } else {  // error
        console.log(readData);
    }
});
```

Parsing Data

A4.5.5.3 CdS + TMP36 + Node project : code-3

cds_tmp36_node.js

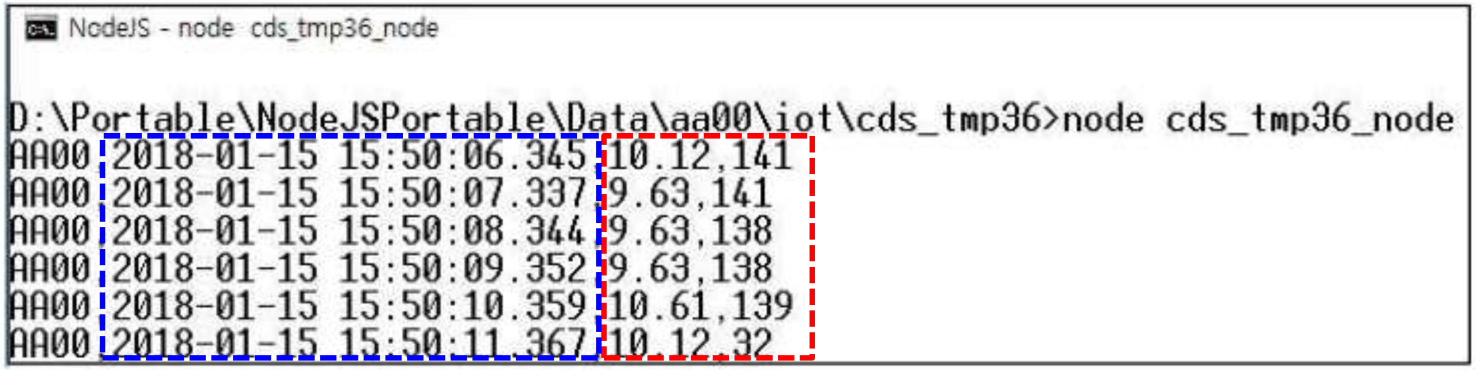


```
// helper function to get a nicely formatted date string for IOT
function getDateString() {
    var time = new Date().getTime();
    // 32400000 is (GMT+9 Korea, GimHae)
    // for your timezone just multiply +/-GMT by 3600000
    var datestr = new Date(time +32400000).
    toISOString().replace(/T/, ' ').replace(/Z/, '');
    return datestr;
}

io.sockets.on('connection', function (socket) {
    // If socket.io receives message from the client browser then
    // this call back will be executed.
    socket.on('message', function (msg) {
        console.log(msg);
    });
    // If a web browser disconnects from Socket.IO then this callback is called.
    socket.on('disconnect', function () {
        console.log('disconnected');
    });
});
```

A4.5.6 CdS + TMP36 + Node project : result

Node cmd 에서 실행

```
node cds_tmp36_node
```



NodeJS - node cds_tmp36_node

```
D:\Portable\NodeJSPortable\Data\aa00\iot\cds_tmp36>node cds_tmp36_node
AA00,2018-01-15 15:50:06.345,10.12,141
AA00,2018-01-15 15:50:07.337,9.63,141
AA00,2018-01-15 15:50:08.344,9.63,138
AA00,2018-01-15 15:50:09.352,9.63,138
AA00,2018-01-15 15:50:10.359,10.61,139
AA00,2018-01-15 15:50:11.367,10.12,32
```

IOT data format

시간, 온도,조도

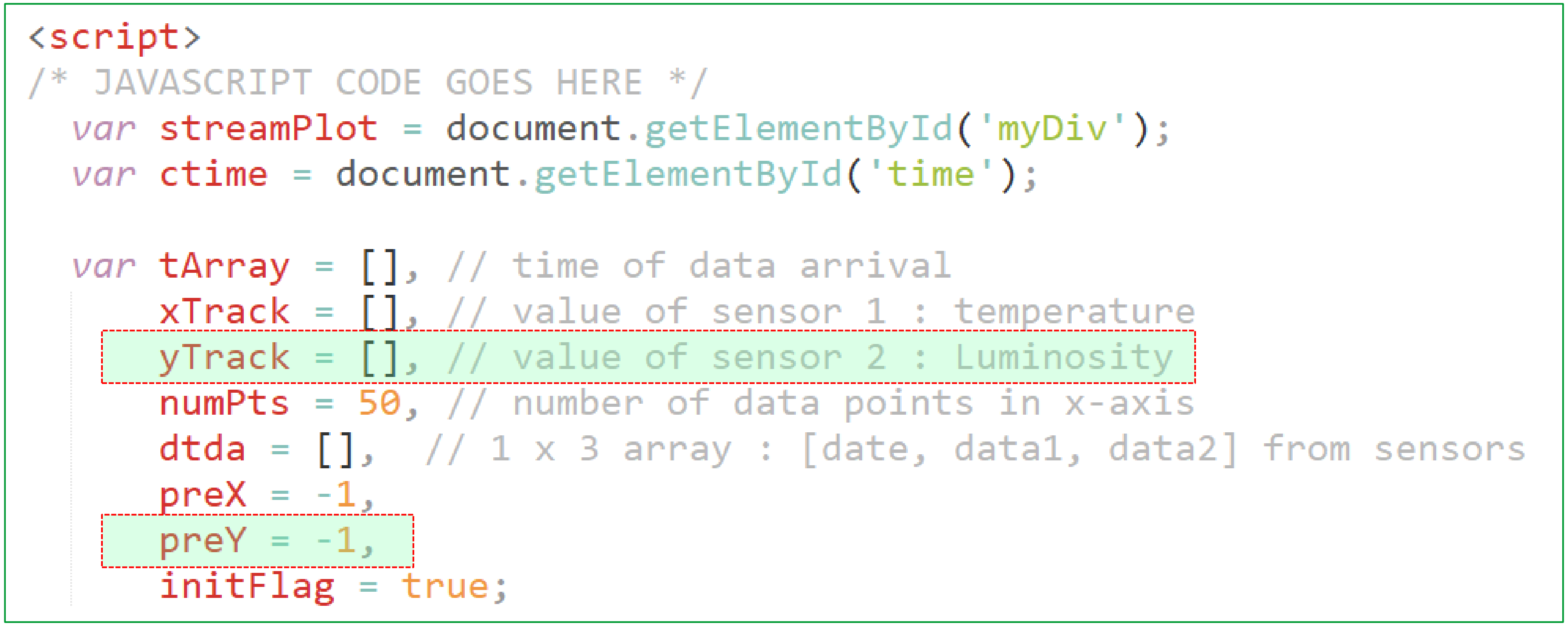
A5.6.1 TMP36 + CdS streaming project

[DIY] Client html : client_cds_tmp36.html (data from multi sensors)

```
<!DOCTYPE html>
<head>
  <meta charset="utf-8">
  <title>plotly.js client: Real time signals from sensors</title>
  <script src="https://cdn.plot.ly/plotly-latest.min.js"></script>
  <script type="text/javascript" src="https://cdnjs.cloudflare.com/ajax/libs/
  socket.io/1.3.6/socket.io.js"></script>

  <script src="gauge.min.js"></script>

  <style>body{padding:0;margin:30;background:#fff}</style>
</head>

<body>  <!-- style="width:100%;height:100%"> -->
<!-- Plotly chart will be drawn inside this DIV -->
<h1 align="center">Real-time Temperature(°C) and Luminosity(lux) from sensors</h1>
<div align="center">
    <!-- 1st gauge -->
    <canvas id="gauge1"> </canvas>
    <!-- 2nd gauge -->
    <canvas id="gauge2"> </canvas>
</div>

<h3 align="center"> on Time: <span id="time"> </span> </h3>

<div id="myDiv"></div> <!-- graph here! -->

<hr>
```

A5.6.2 TMP36 + CdS streaming project

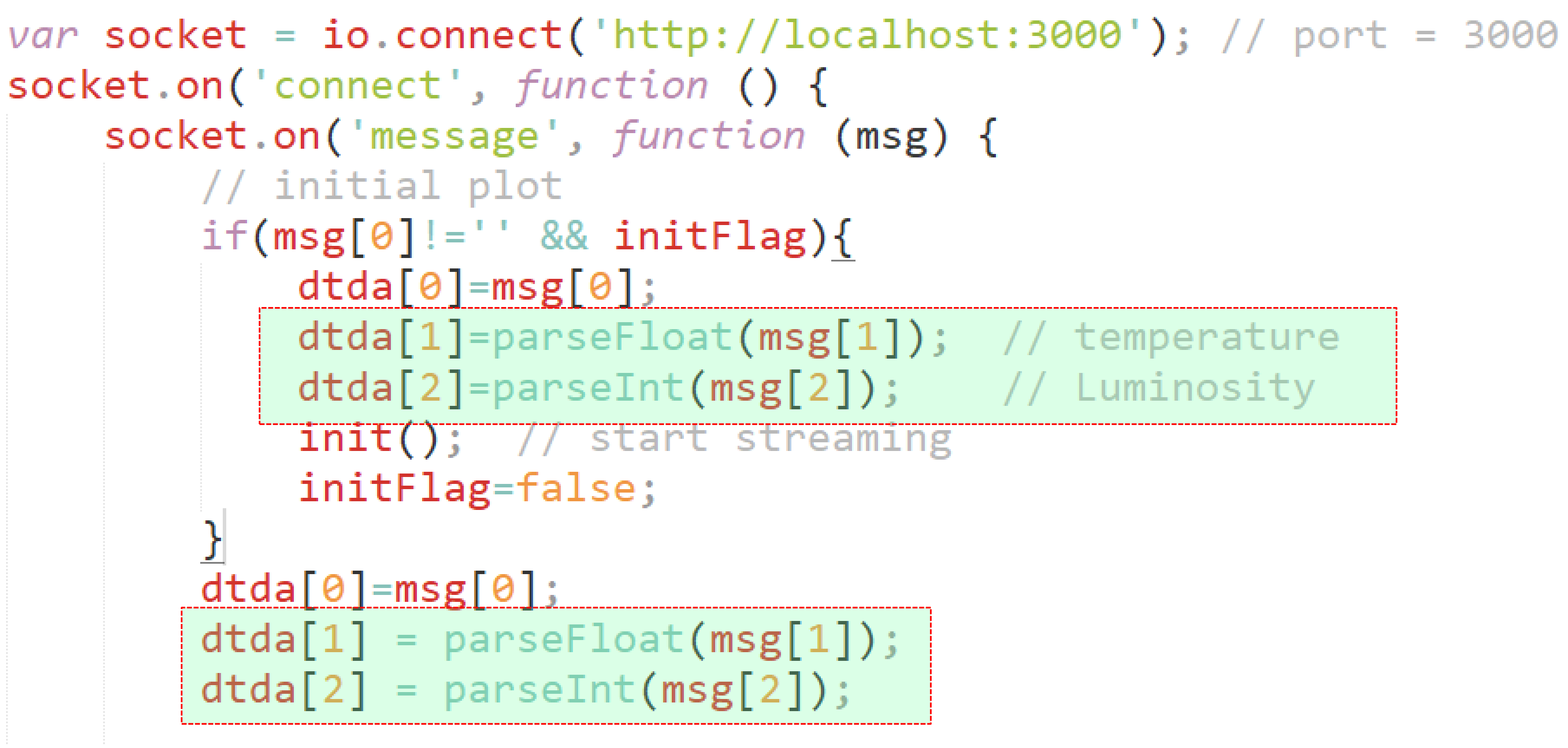
[DIY] Client html : client_cds_tmp36.html (data from multi sensors)



```
<script>
/* JAVASCRIPT CODE GOES HERE */
  var streamPlot = document.getElementById('myDiv');
  var ctime = document.getElementById('time');

  var tArray = [], // time of data arrival
      xTrack = [], // value of sensor 1 : temperature
      yTrack = [], // value of sensor 2 : Luminosity
      numPts = 50, // number of data points in x-axis
      dtda = [],  // 1 x 3 array : [date, data1, data2] from sensors
      preX = -1,
      preY = -1,
      initFlag = true;
```

A5.6.3 TMP36 + CdS streaming project

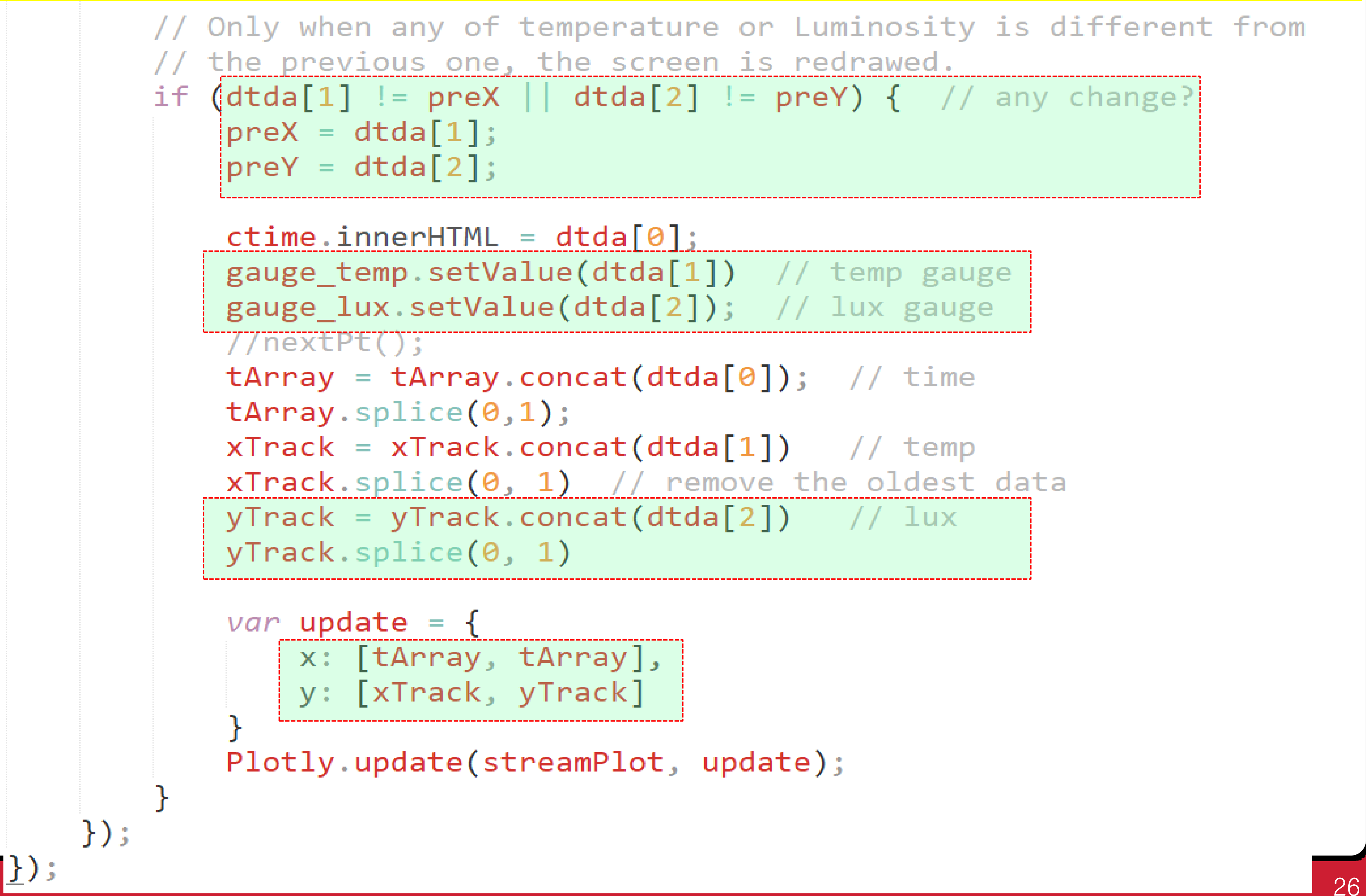
[DIY] Client html : client_cds_tmp36.html (data from multi sensors)



```
var socket = io.connect('http://localhost:3000'); // port = 3000
socket.on('connect', function () {
    socket.on('message', function (msg) {
        // initial plot
        if(msg[0]!='' && initFlag){
            dtda[0]=msg[0];
            dtda[1]=parseFloat(msg[1]);  // temperature
            dtda[2]=parseInt(msg[2]);    // Luminosity
            init();  // start streaming
            initFlag=false;
        }
        dtda[0]=msg[0];
        dtda[1] = parseFloat(msg[1]);
        dtda[2] = parseInt(msg[2]);
```

A5.6.4 TMP36 + CdS streaming project

[DIY] Client html : client_cds_tmp36.html (data from multi sensors)



```
            // Only when any of temperature or Luminosity is different from
            // the previous one, the screen is redrawed.
            if (dtda[1] != preX || dtda[2] != preY) {  // any change?
                preX = dtda[1];
                preY = dtda[2];

                ctime.innerHTML = dtda[0];
                gauge_temp.setValue(dtda[1])  // temp gauge
                gauge_lux.setValue(dtda[2]);  // lux gauge
                //nextPt();
                tArray = tArray.concat(dtda[0]);  // time
                tArray.splice(0,1);
                xTrack = xTrack.concat(dtda[1])   // temp
                xTrack.splice(0, 1)  // remove the oldest data
                yTrack = yTrack.concat(dtda[2])   // lux
                yTrack.splice(0, 1)

                var update = {
                    x: [tArray, tArray],
                    y: [xTrack, yTrack]
                }
                Plotly.update(streamPlot, update);
            }
        });
});
```

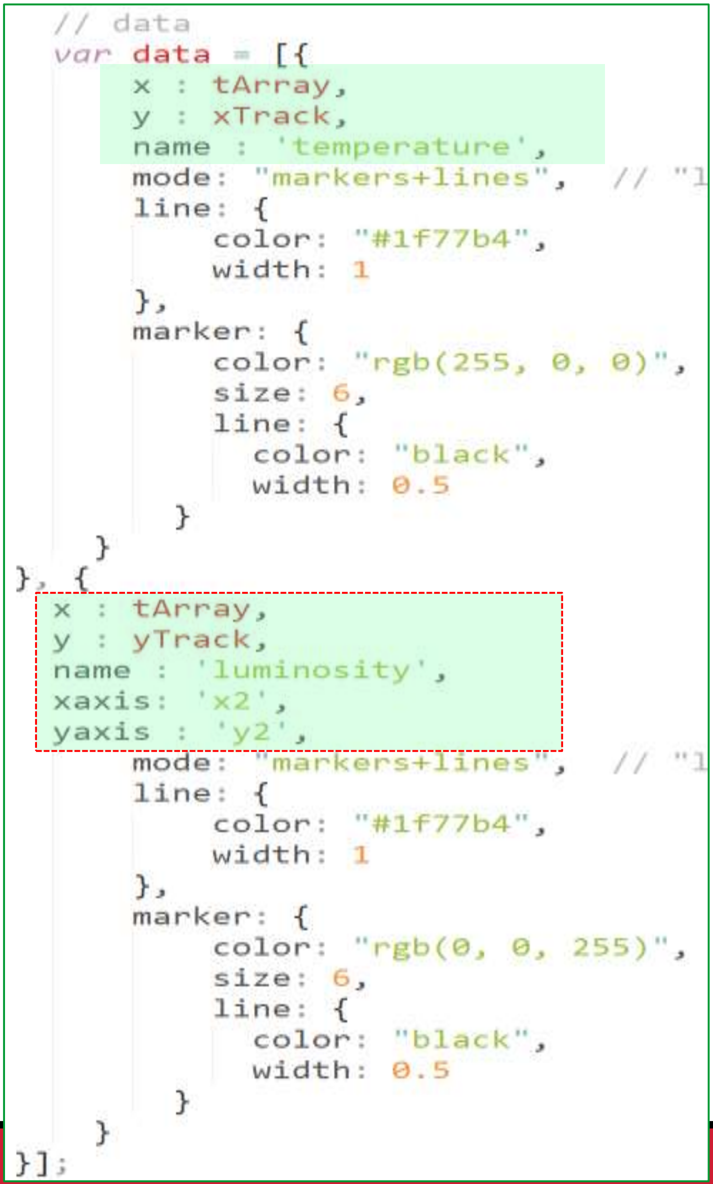
A5.6.5 TMP36 + CdS streaming project

[DIY] Client html : client_cds_tmp36.html (data from multi sensors)

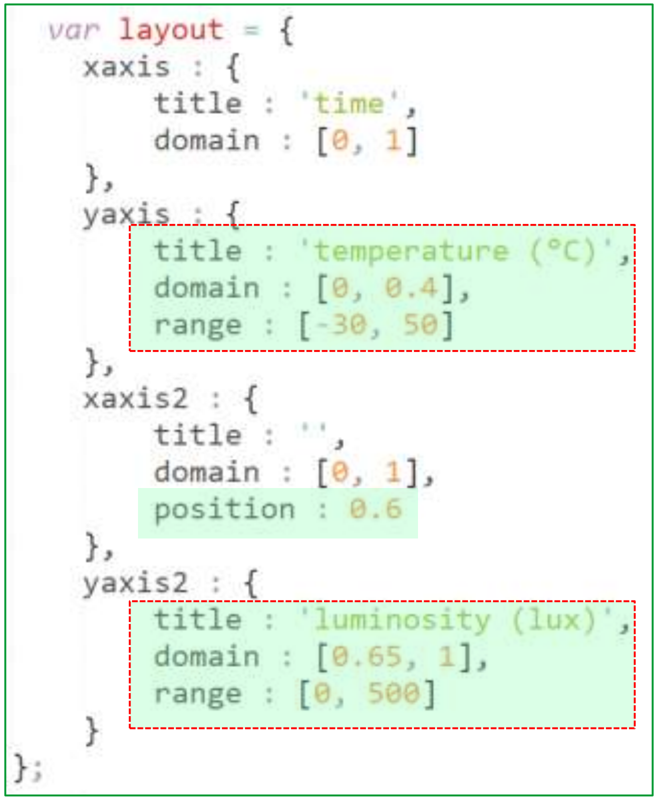
```
function init() {  // initial screen ()
    // starting point : first data (temp, lux)
    for ( i = 0; i < numPts; i++) {
        tArray.push(dtda[0]);  // date
        xTrack.push(dtda[1]);  // sensor 1 (temp)
        yTrack.push(dtda[2]);  // sensor 2 (lux)
    }

    Plotly.plot(streamPlot, data, layout);
}
```

A5.6.6 TMP36 + CdS streaming project

[DIY] Client html : client_cds_tmp36.html (data from multi sensors)



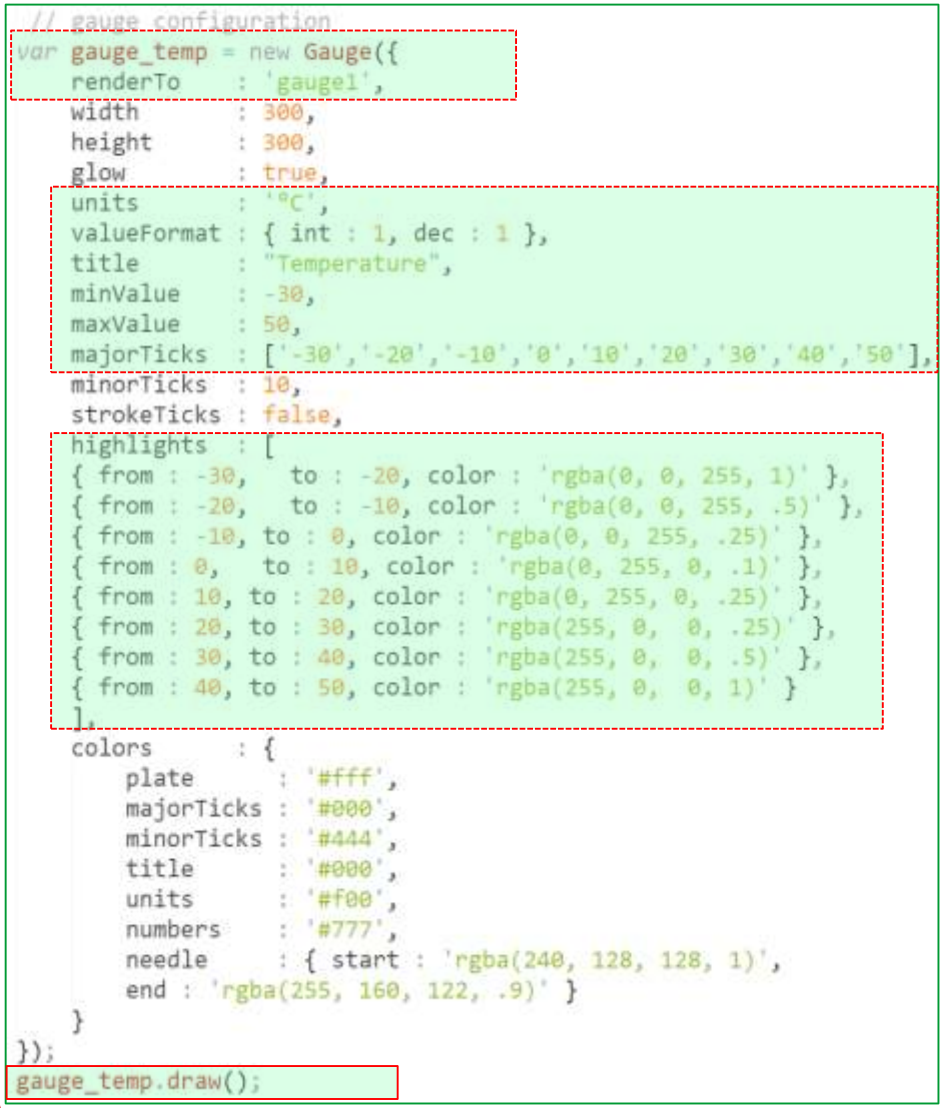
```
  // data
  var data = [{
      x : tArray,
      y : xTrack,
      name : 'temperature',
      mode: "markers+lines",   // "l
      line: {
          color: "#1f77b4",
          width: 1
      },
      marker: {
          color: "rgb(255, 0, 0)",
          size: 6,
          line: {
            color: "black",
            width: 0.5
          }
      }
}, {
  x : tArray,
  y : yTrack,
  name : 'luminosity',
  xaxis: 'x2',
  yaxis : 'y2',
      mode: "markers+lines",   // "l
      line: {
          color: "#1f77b4",
          width: 1
      },
      marker: {
          color: "rgb(0, 0, 255)",
          size: 6,
          line: {
            color: "black",
            width: 0.5
          }
      }
}];
```



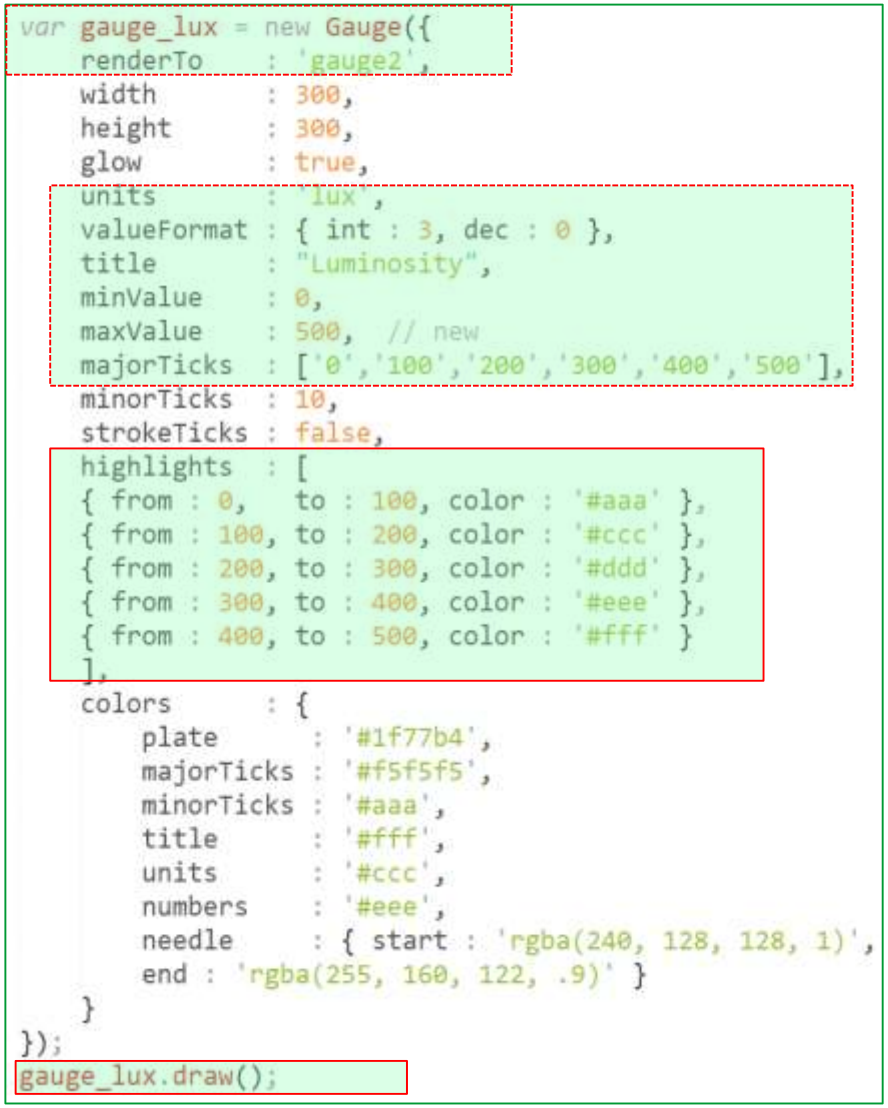
```
  var layout = {
    xaxis : {
        title : 'time',
        domain : [0, 1]
    },
    yaxis : {
        title : 'temperature (°C)',
        domain : [0, 0.4],
        range : [-30, 50]
    },
    xaxis2 : {
        title : '',
        domain : [0, 1],
        position : 0.6
    },
    yaxis2 : {
        title : 'luminosity (lux)',
        domain : [0.65, 1],
        range : [0, 500]
    }
};
```

A5.6.7 TMP36 + CdS streaming project

[DIY] Client html : client_cds_tmp36.html (data from multi sensors)



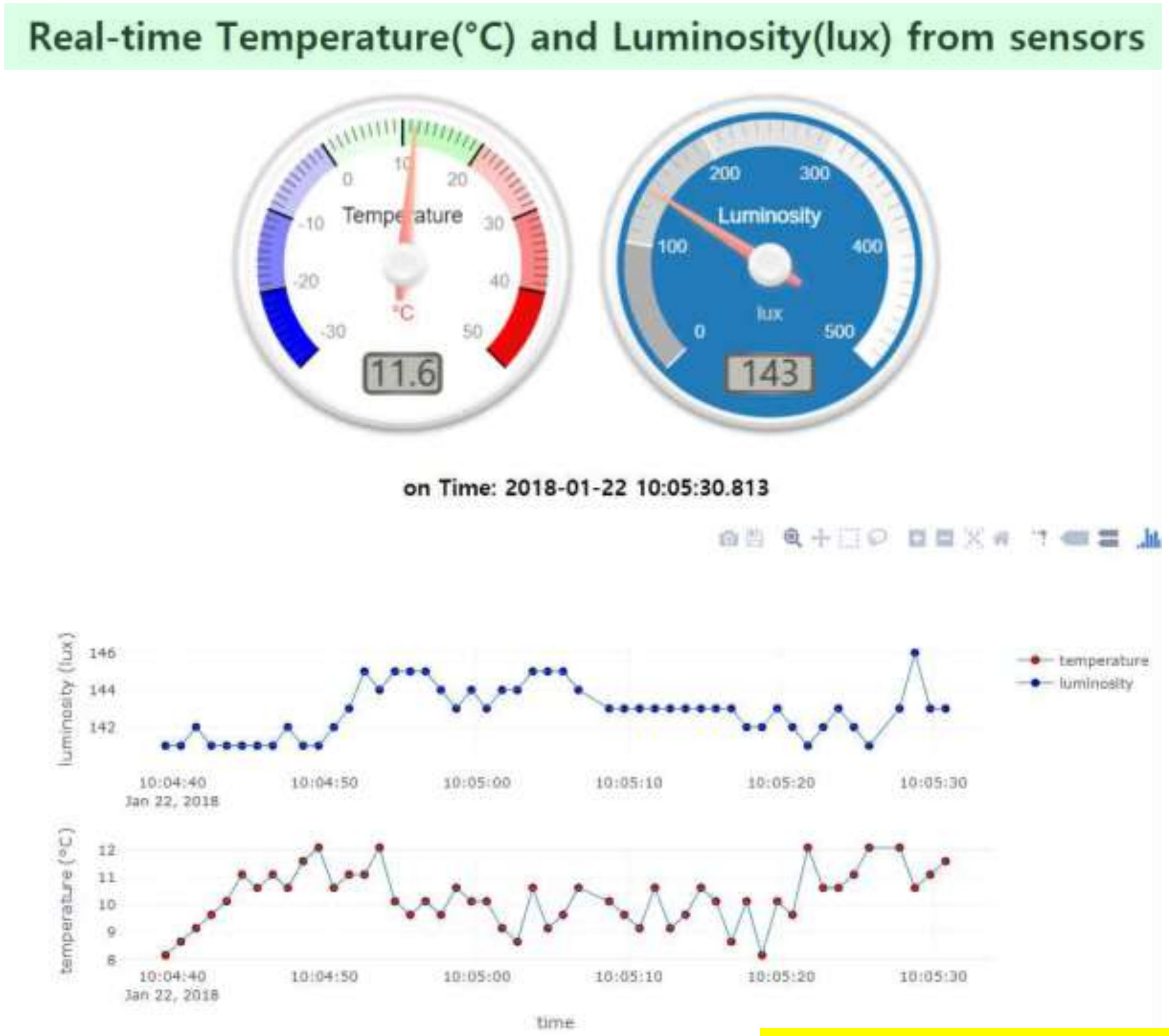
```
// gauge configuration
var gauge_temp = new Gauge({
    renderTo    : 'gauge1',
    width       : 300,
    height      : 300,
    glow        : true,
    units       : '°C',
    valueFormat : { int : 1, dec : 1 },
    title       : "Temperature",
    minValue    : -30,
    maxValue    : 50,
    majorTicks  : ['-30','-20','-10','0','10','20','30','40','50'],
    minorTicks  : 10,
    strokeTicks : false,
    highlights  : [
    { from : -30,   to : -20, color : 'rgba(0, 0, 255, 1)' },
    { from : -20,   to : -10, color : 'rgba(0, 0, 255, .5)' },
    { from : -10, to : 0, color : 'rgba(0, 0, 255, .25)' },
    { from : 0,    to : 10, color : 'rgba(0, 255, 0, .1)' },
    { from : 10, to : 20, color : 'rgba(0, 255, 0, .25)' },
    { from : 20, to : 30, color : 'rgba(255, 0,  0, .25)' },
    { from : 30, to : 40, color : 'rgba(255, 0,  0, .5)' },
    { from : 40, to : 50, color : 'rgba(255, 0,  0, 1)' }
    ],
    colors      : {
        plate      : '#fff',
        majorTicks : '#000',
        minorTicks : '#444',
        title      : '#000',
        units      : '#f00',
        numbers    : '#777',
        needle     : { start : 'rgba(240, 128, 128, 1)',
        end : 'rgba(255, 160, 122, .9)' }
    }
});
gauge_temp.draw();
```



```
var gauge_lux = new Gauge({
    renderTo    : 'gauge2',
    width       : 300,
    height      : 300,
    glow        : true,
    units       : 'lux',
    valueFormat : { int : 3, dec : 0 },
    title       : "Luminosity",
    minValue    : 0,
    maxValue    : 500,   // new
    majorTicks  : ['0','100','200','300','400','500'],
    minorTicks  : 10,
    strokeTicks : false,
    highlights  : [
    { from : 0,   to : 100, color : '#aaa' },
    { from : 100, to : 200, color : '#ccc' },
    { from : 200, to : 300, color : '#ddd' },
    { from : 300, to : 400, color : '#eee' },
    { from : 400, to : 500, color : '#fff' }
    ],
    colors      : {
        plate      : '#1f77b4',
        majorTicks : '#f5f5f5',
        minorTicks : '#aaa',
        title      : '#fff',
        units      : '#ccc',
        numbers    : '#eee',
        needle     : { start : 'rgba(240, 128, 128, 1)',
        end : 'rgba(255, 160, 122, .9)' }
    }
});
gauge_lux.draw();
```

A5.6.8 TMP36 + CdS streaming project

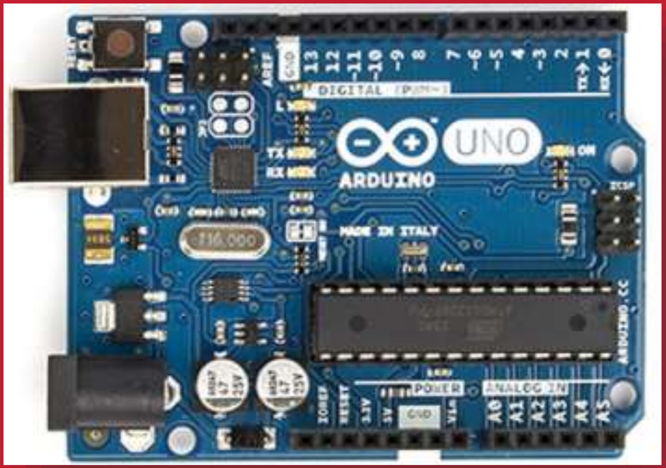
[DIY] Client html : client_cds_tmp36.html (result)


Real-time Temperature(°C) and Luminosity(lux) from sensors

on Time: 2018-01-22 10:05:30.813

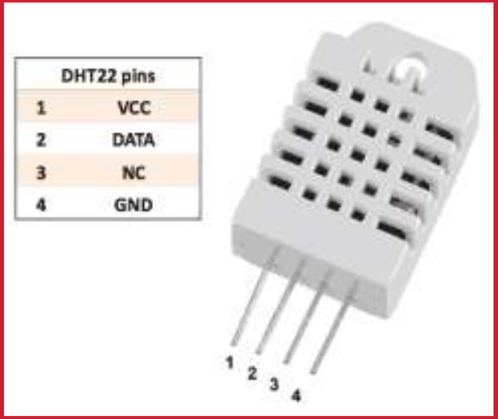
AAnn_DS_cds_tmp36.png 로 저장

CdS + DHT22 + plotly.js Node project



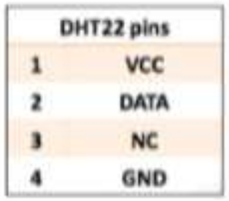
Multi-sensors

DHT22 + CdS



DHT22 pins

1	VCC
2	DATA
3	NC
4	GND



DHT22 pins	
1	VCC
2	DATA
3	NC
4	GND

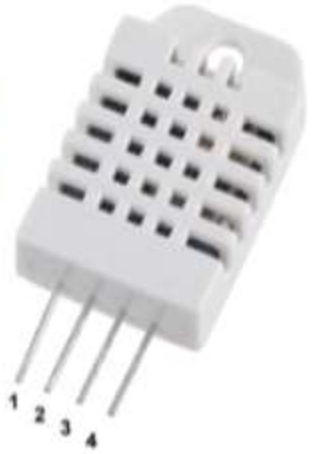
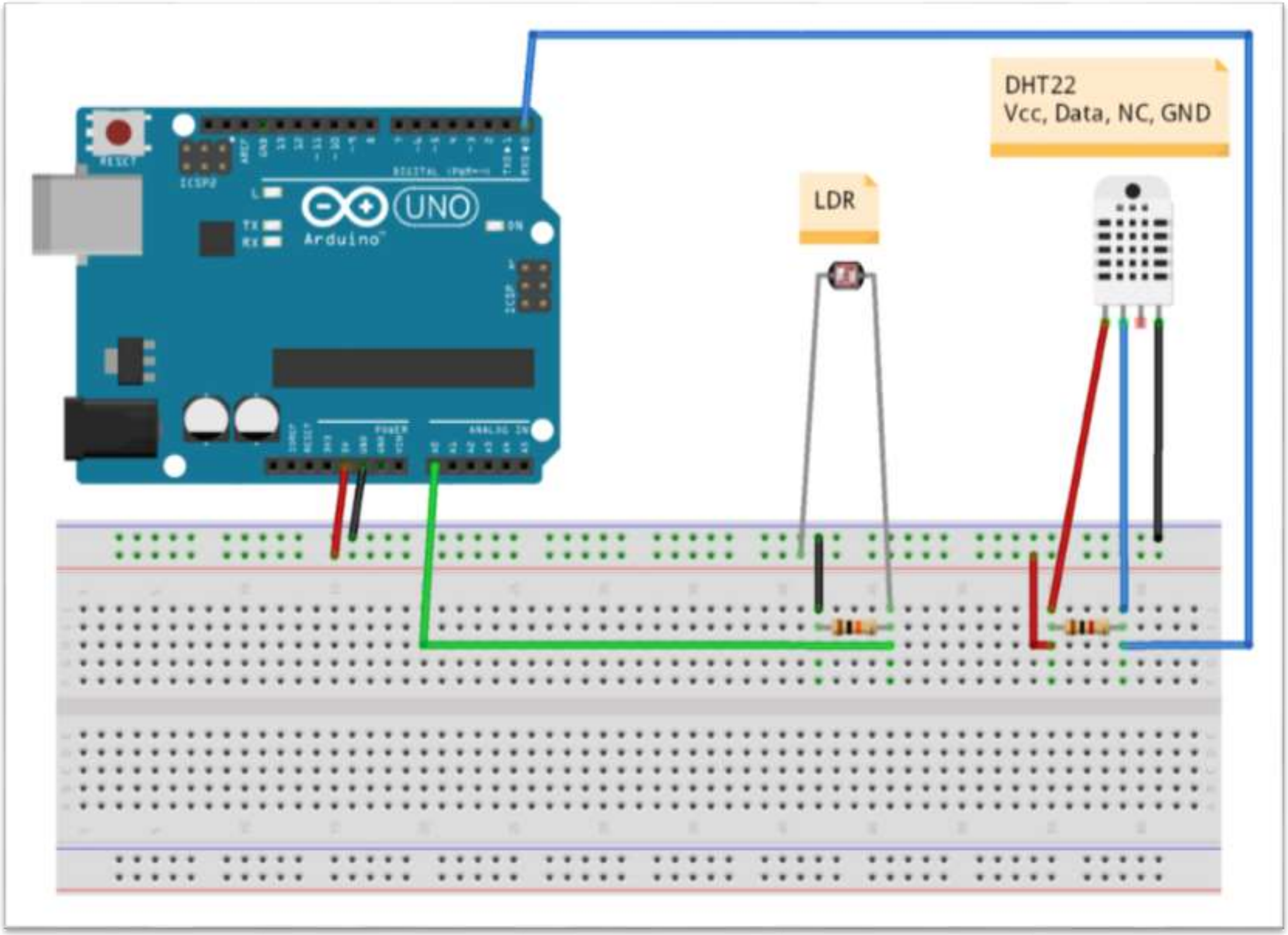


그림 8-7 DHT22 pin 구조

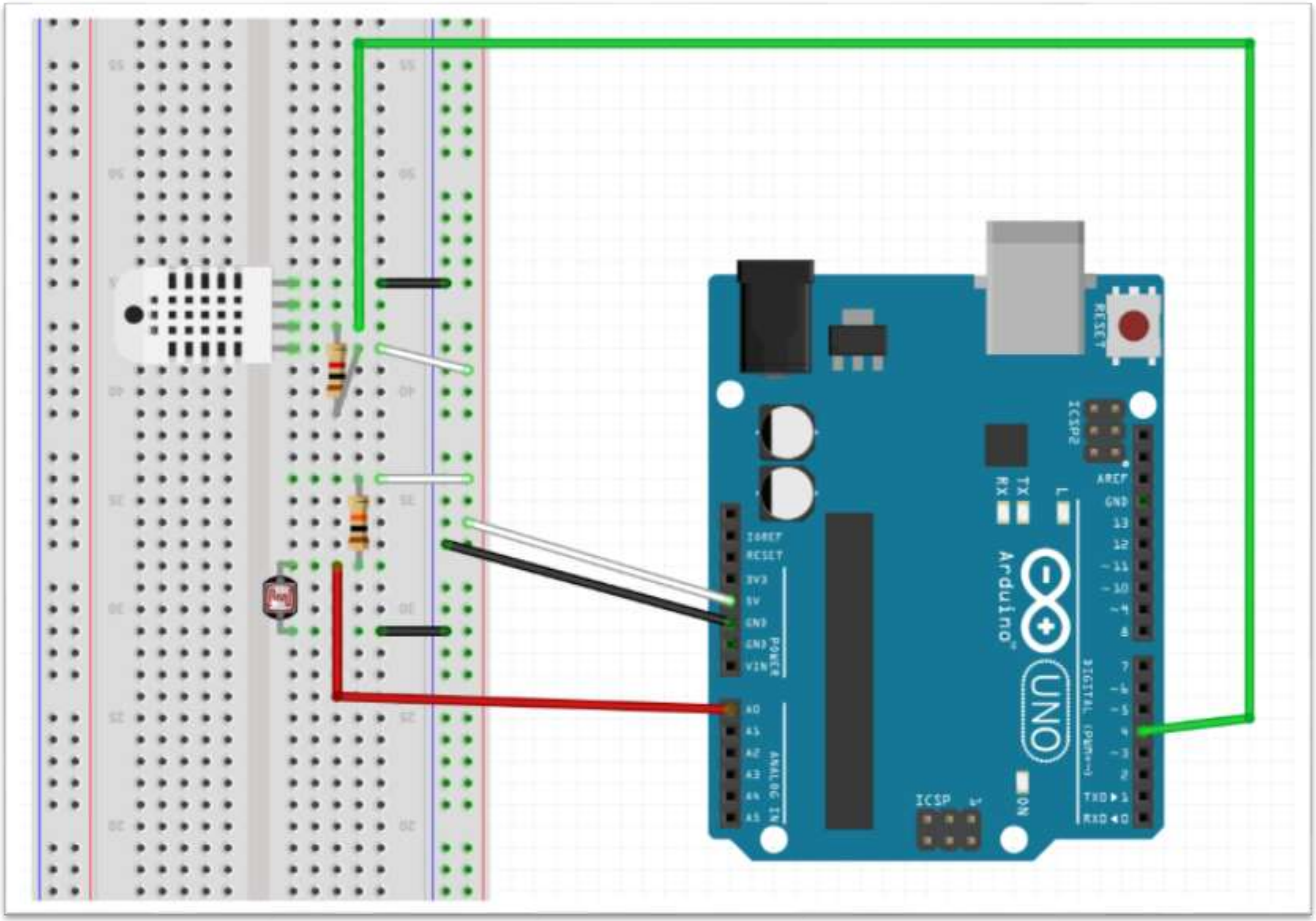
- 3 ~ 5V power and I/O
- 2.5mA max current
- [0-100%] humidity readings with 2-5% accuracy
- [-40 to 80°C] temperature readings ±0.5°C accuracy
- 0.5 Hz sampling rate

https://learn.adafruit.com/dht/overview

A5.7 DHT22 + CdS streaming project

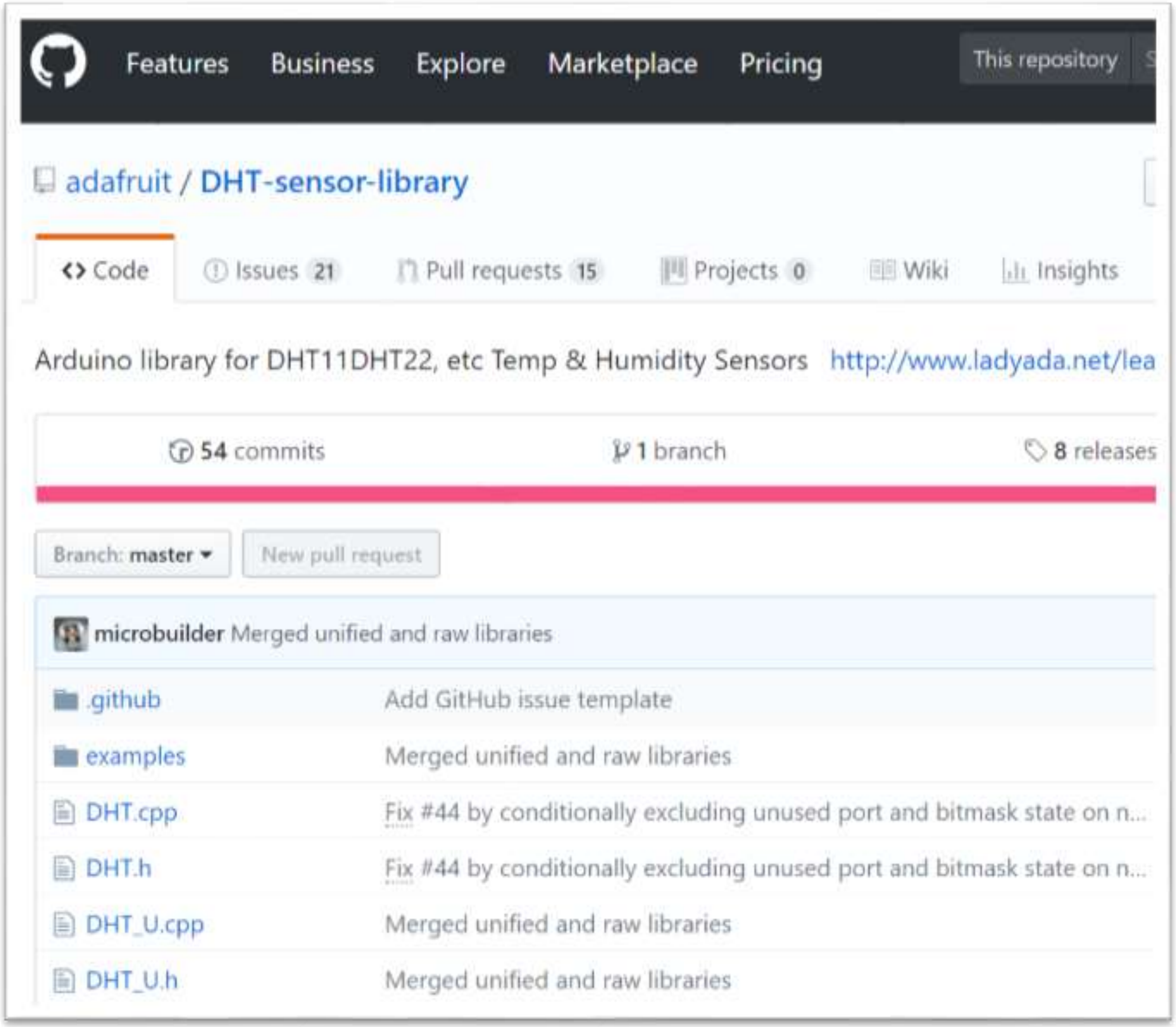


A5.7.1 DHT22 + CdS circuit



DHT22 + 1 kΩ,   CdS + 10 k Ω

A5.7.2 DHT22 + CdS : DHT library


Features Business Explore Marketplace Pricing This repository

adafruit / DHT-sensor-library

<> Code | Issues 21 | Pull requests 15 | Projects 0 | Wiki | Insights

Arduino library for DHT11DHT22, etc Temp & Humidity Sensors http://www.ladyada.net/lea

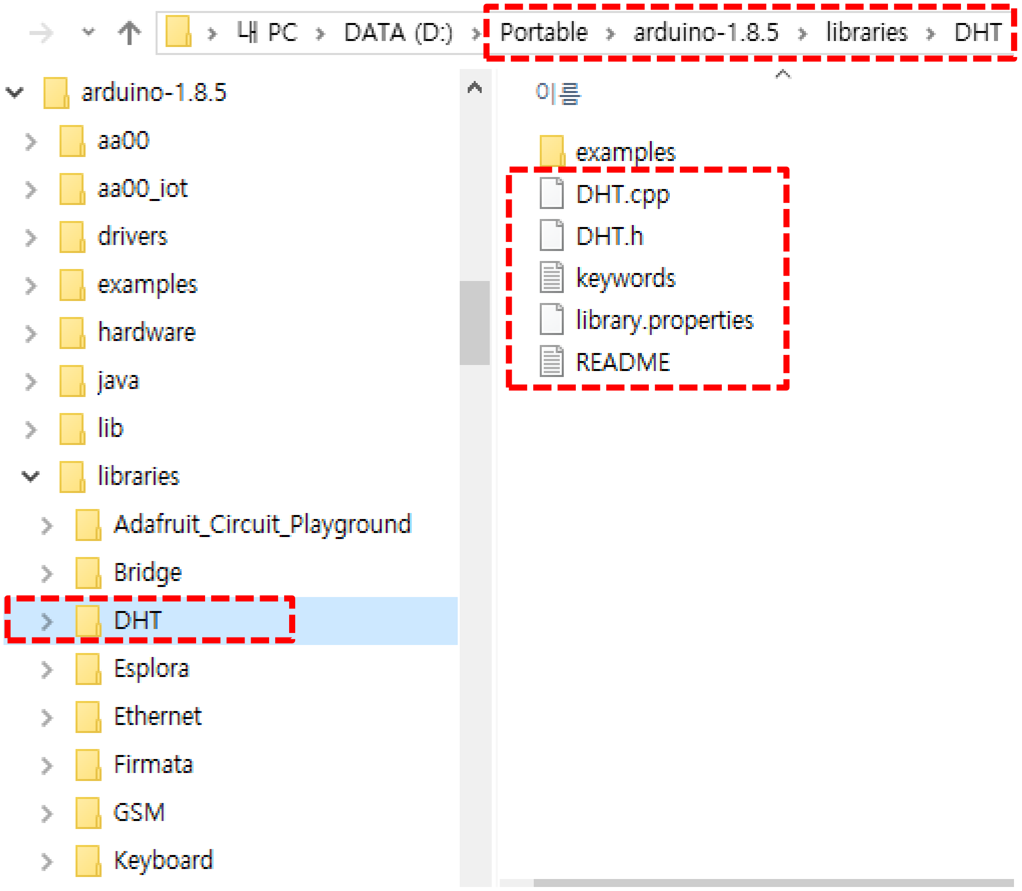
54 commits 1 branch 8 releases

Branch: master ▾ New pull request

microbuilder Merged unified and raw libraries

.github	Add GitHub issue template
examples	Merged unified and raw libraries
DHT.cpp	Fix #44 by conditionally excluding unused port and bitmask state on n...
DHT.h	Fix #44 by conditionally excluding unused port and bitmask state on n...
DHT_U.cpp	Merged unified and raw libraries
DHT_U.h	Merged unified and raw libraries

A5.7.3 DHT22 + CdS : DHT library



내 PC › DATA (D:) › Portable › arduino-1.8.5 › libraries › DHT

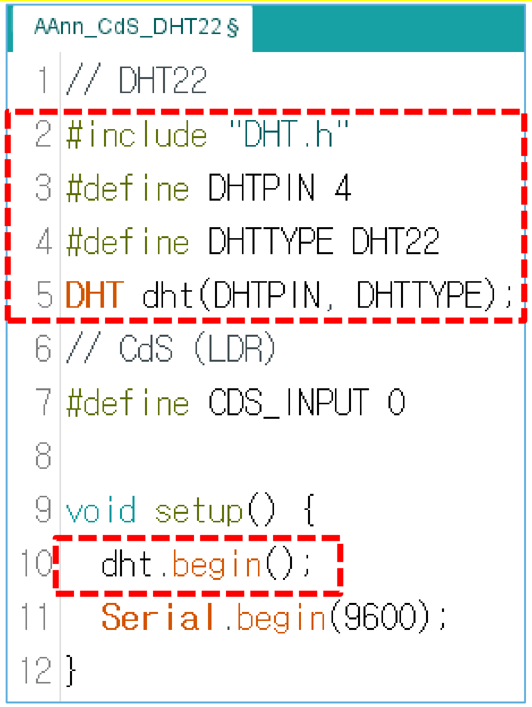
- arduino-1.8.5
  - aa00
  - aa00_iot
  - drivers
  - examples
  - hardware
  - java
  - lib
  - libraries
    - Adafruit_Circuit_Playground
    - Bridge
    - DHT
    - Esplora
    - Ethernet
    - Firmata
    - GSM
    - Keyboard

이름

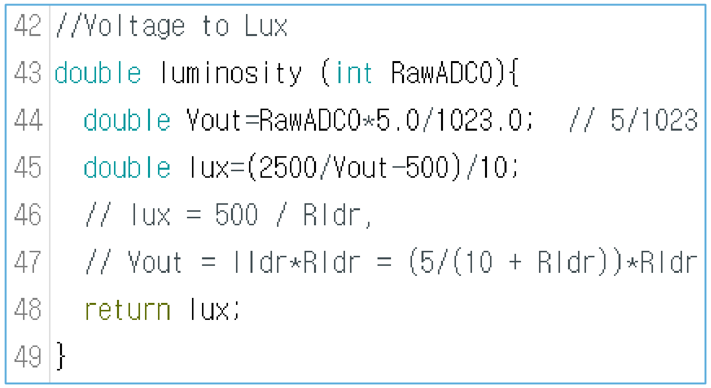
- examples
- DHT.cpp
- DHT.h
- keywords
- library.properties
- README

A5.7.4 DHT22 + CdS : circuit

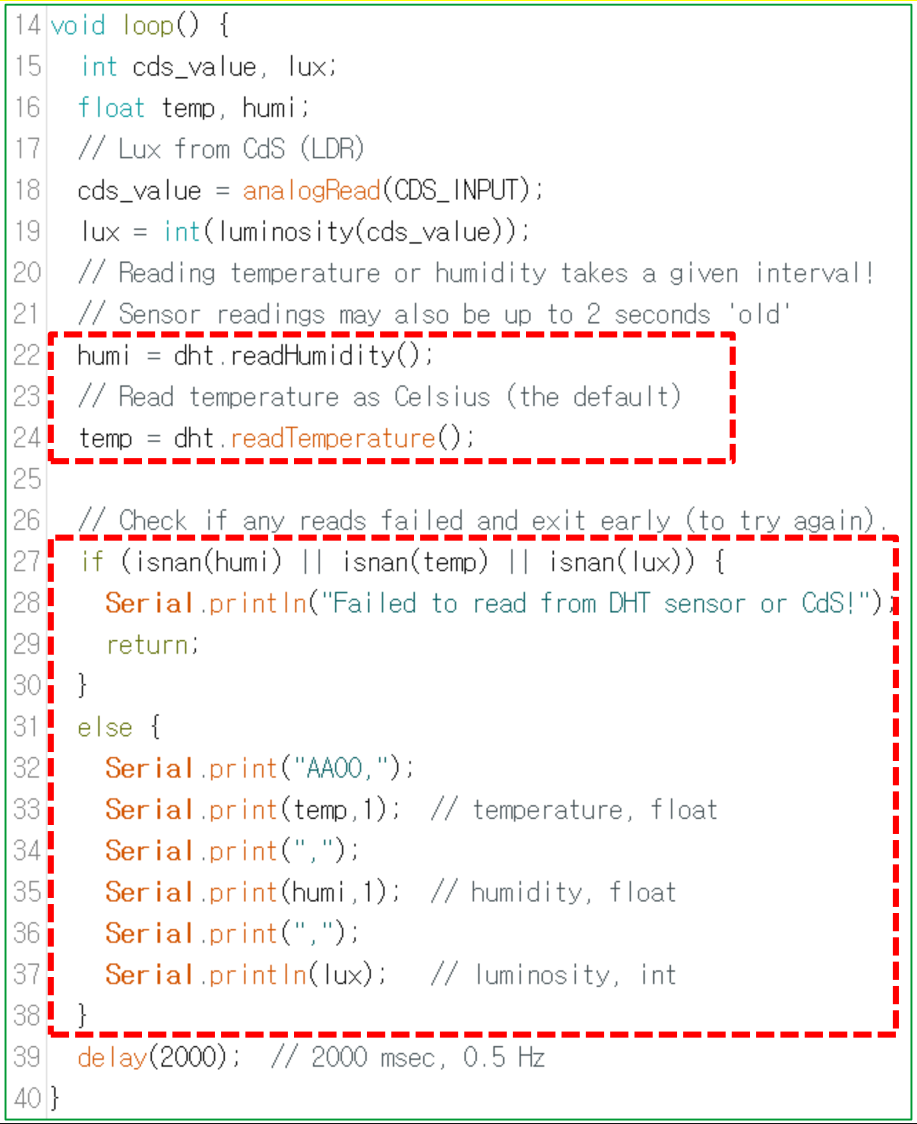
[1] Arduino code: AAnn_CdS_DHT22.ino



```
// DHT22
#include "DHT.h"
#define DHTPIN 4
#define DHTTYPE DHT22
DHT dht(DHTPIN, DHTTYPE);
// CdS (LDR)
#define CDS_INPUT 0

void setup() {
  dht.begin();
  Serial.begin(9600);
}
```



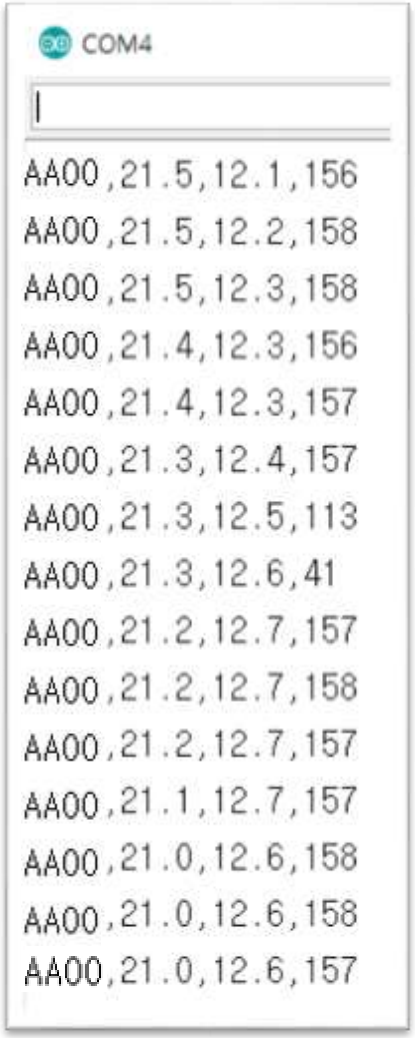
```
//Voltage to Lux
double luminosity (int RawADC0){
  double Vout=RawADC0*5.0/1023.0;  // 5/1023
  double lux=(2500/Vout-500)/10;
  // lux = 500 / Rldr,
  // Vout = Ildr*Rldr = (5/(10 + Rldr))*Rldr
  return lux;
}
```



```
void loop() {
  int cds_value, lux;
  float temp, humi;
  // Lux from CdS (LDR)
  cds_value = analogRead(CDS_INPUT);
  lux = int(luminosity(cds_value));
  // Reading temperature or humidity takes a given interval!
  // Sensor readings may also be up to 2 seconds 'old'
  humi = dht.readHumidity();
  // Read temperature as Celsius (the default)
  temp = dht.readTemperature();

  // Check if any reads failed and exit early (to try again).
  if (isnan(humi) || isnan(temp) || isnan(lux)) {
    Serial.println("Failed to read from DHT sensor or CdS!");
    return;
  }
  else {
    Serial.print("AA00,");
    Serial.print(temp,1);  // temperature, float
    Serial.print(",");
    Serial.print(humi,1);  // humidity, float
    Serial.print(",");
    Serial.println(lux);   // luminosity, int
  }
  delay(2000);  // 2000 msec, 0.5 Hz
}
```

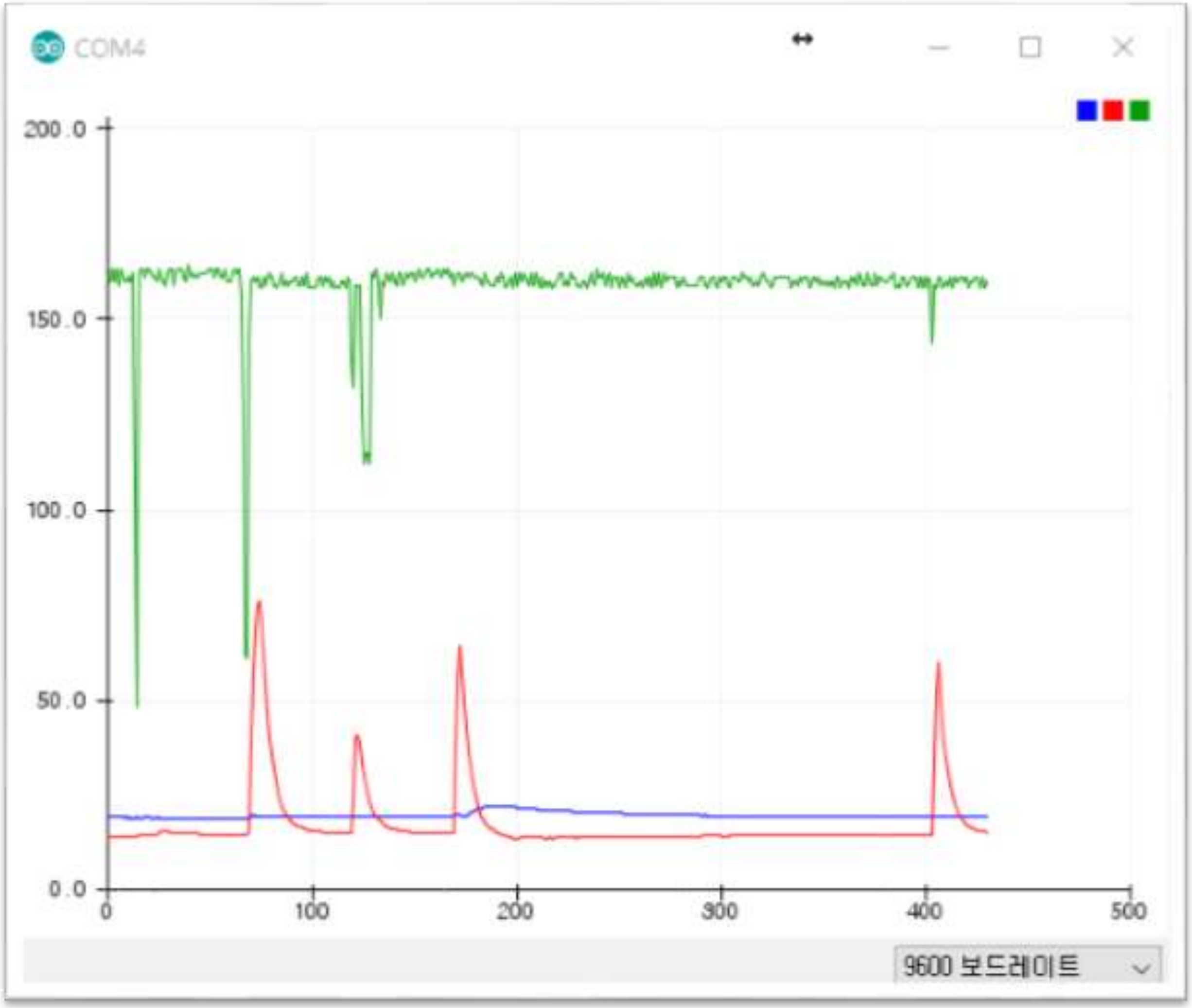
A5.7.5 DHT22 + CdS : Serial monitor

[1] Arduino code: AAnn_CdS_DHT22.ino



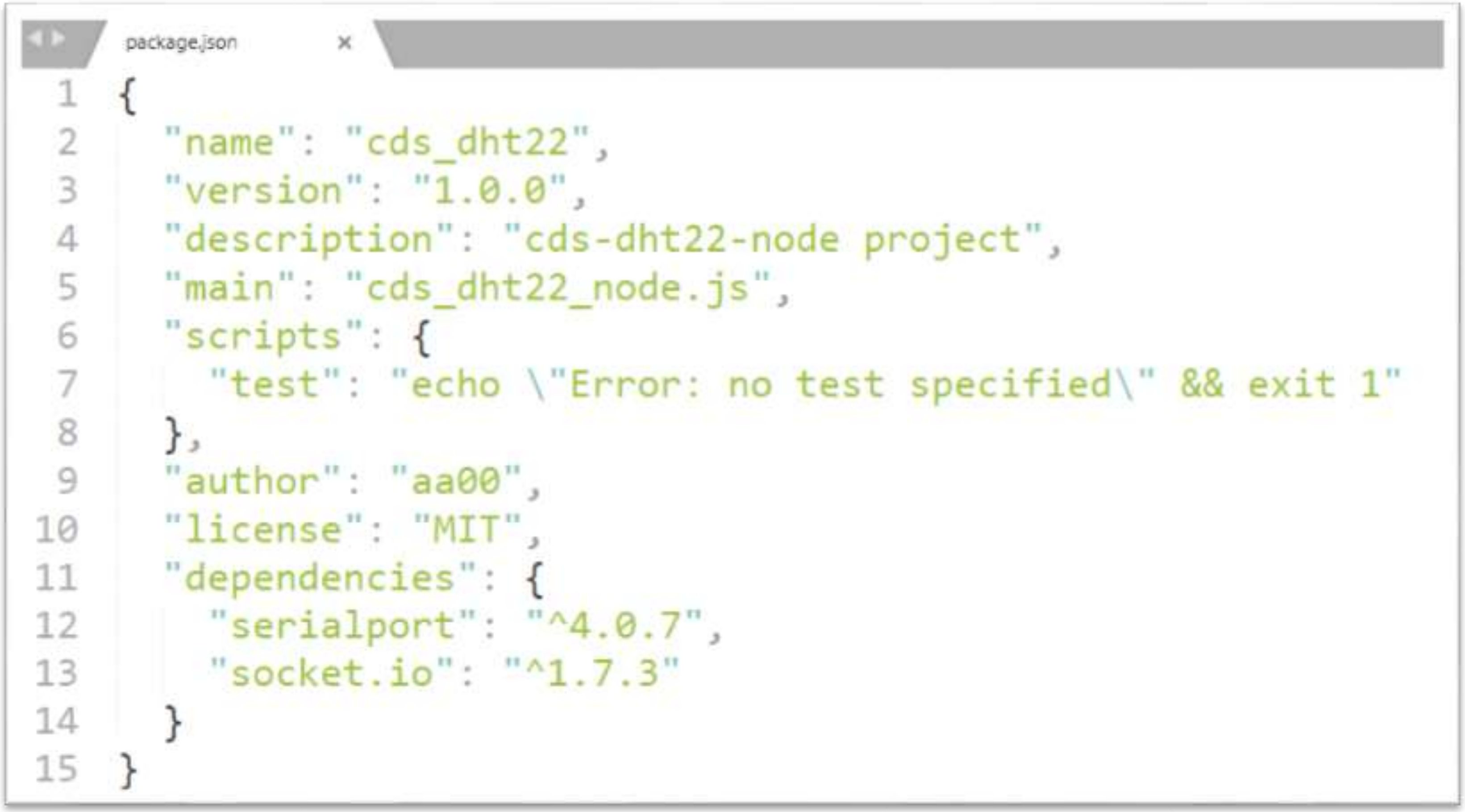
COM4

```
AA00,21.5,12.1,156
AA00,21.5,12.2,158
AA00,21.5,12.3,158
AA00,21.4,12.3,156
AA00,21.4,12.3,157
AA00,21.3,12.4,157
AA00,21.3,12.5,113
AA00,21.3,12.6,41
AA00,21.2,12.7,157
AA00,21.2,12.7,158
AA00,21.2,12.7,157
AA00,21.1,12.7,157
AA00,21.0,12.6,158
AA00,21.0,12.6,158
AA00,21.0,12.6,157
```



A5.7.6 DHT22 + CdS + Node.js

[2.1] NodeJS project: "cds-dht22-node project“ → package.json

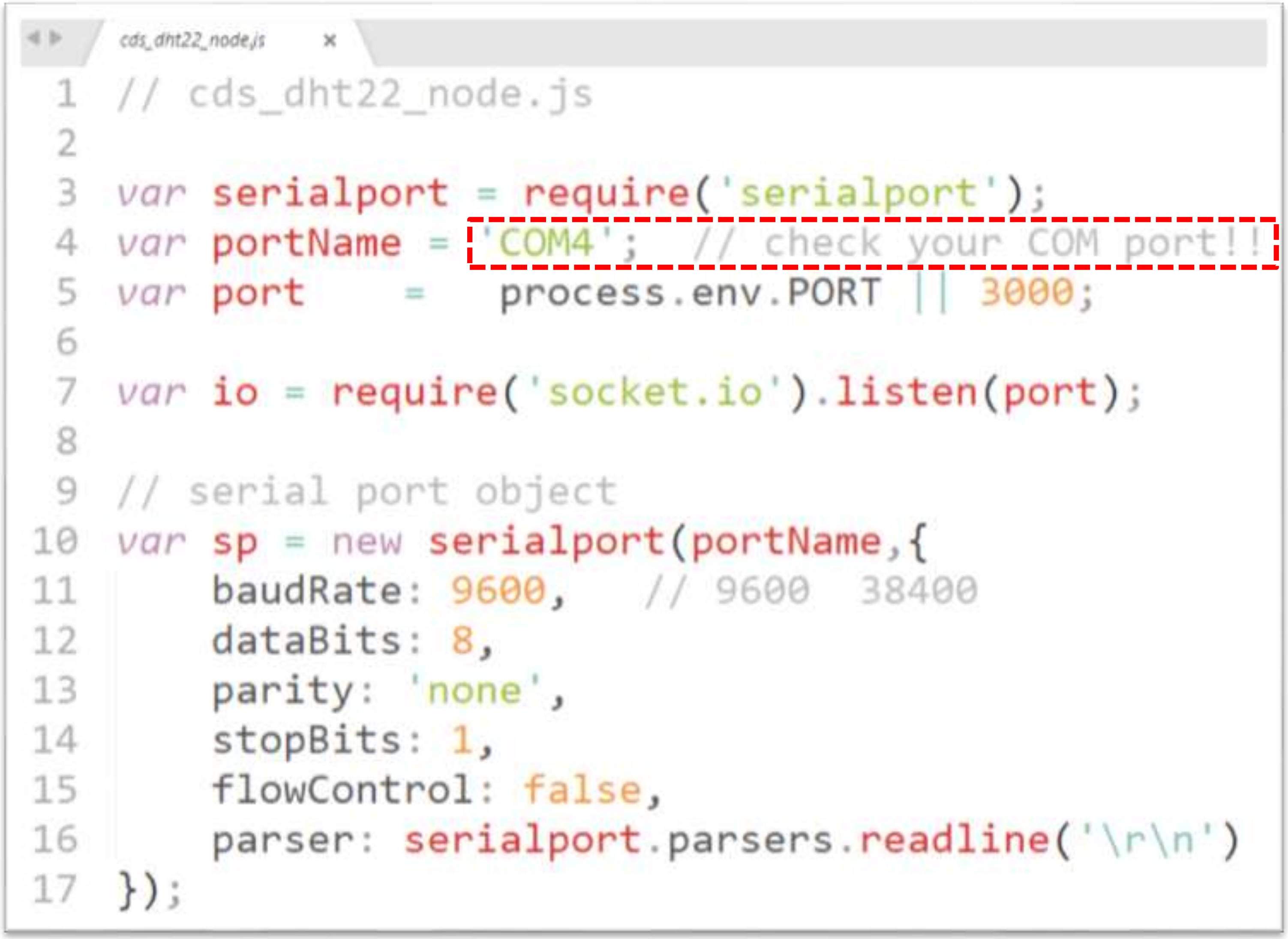


package.json

```
{
  "name": "cds_dht22",
  "version": "1.0.0",
  "description": "cds-dht22-node project",
  "main": "cds_dht22_node.js",
  "scripts": {
    "test": "echo \"Error: no test specified\" && exit 1"
  },
  "author": "aa00",
  "license": "MIT",
  "dependencies": {
    "serialport": "^4.0.7",
    "socket.io": "^1.7.3"
  }
}
```

A5.7.7 DHT22 + CdS + Node.js

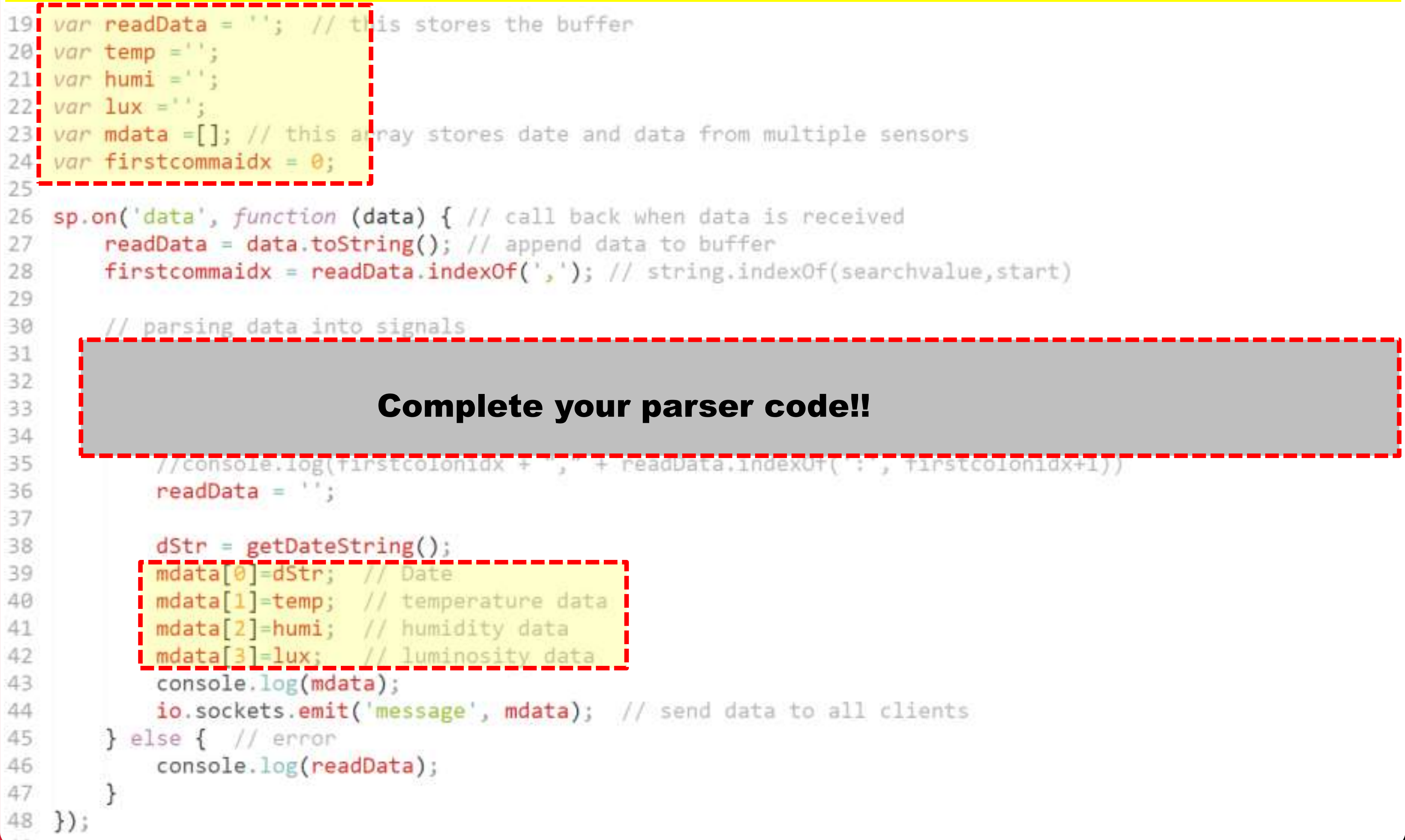
[2.2] NodeJS code: cds_dht22_node.js (← cds_tmp36_node.js를 rename)



```
// cds_dht22_node.js

var serialport = require('serialport');
var portName = 'COM4';   // check your COM port!!
var port     =    process.env.PORT || 3000;

var io = require('socket.io').listen(port);

// serial port object
var sp = new serialport(portName,{
    baudRate: 9600,   // 9600  38400
    dataBits: 8,
    parity: 'none',
    stopBits: 1,
    flowControl: false,
    parser: serialport.parsers.readline('\r\n')
});
```

A5.7.8 DHT22 + CdS + Node.js

[2.3] NodeJS code: cds_dht22_node.js (Complete your parser code)



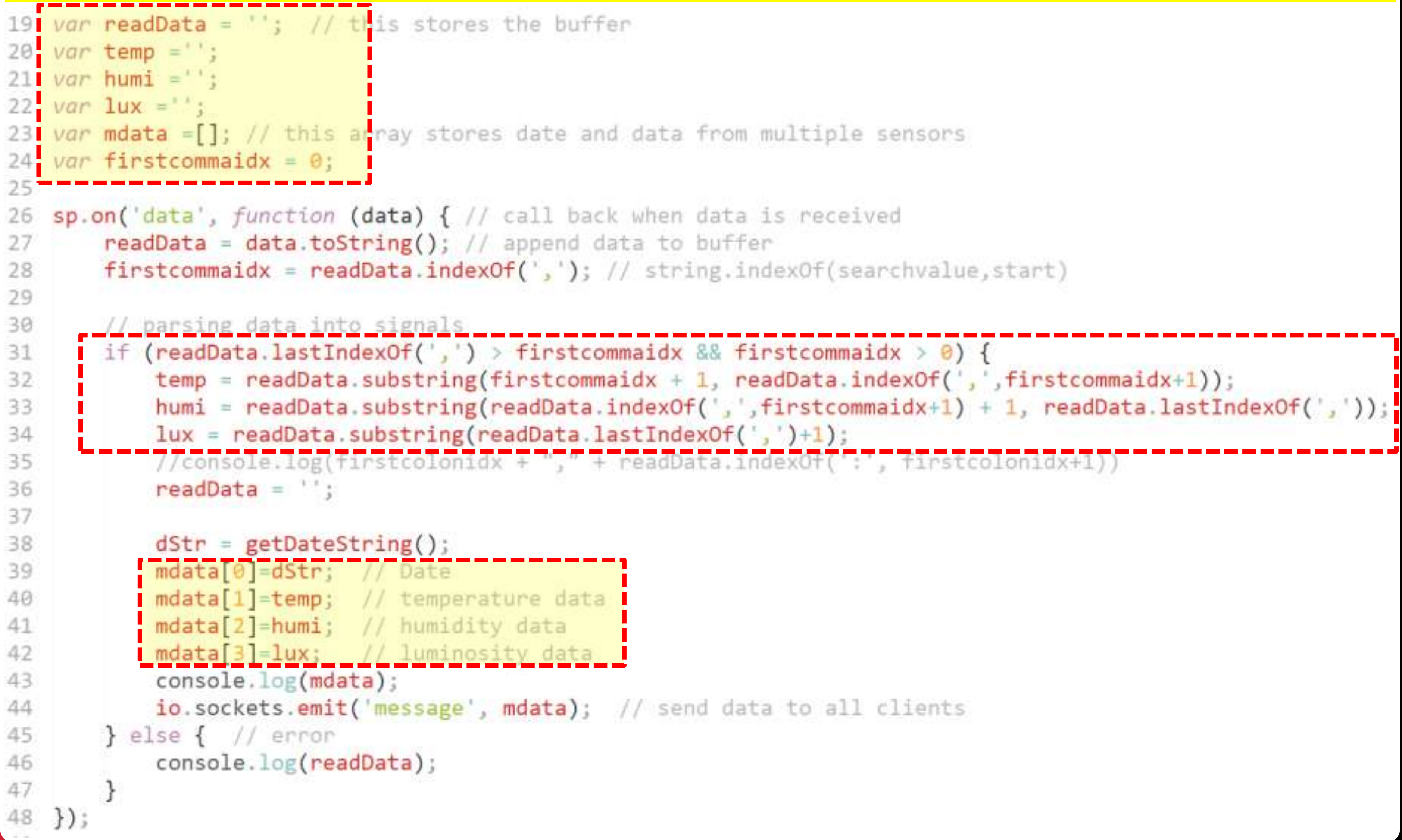
```
var readData = '';  // this stores the buffer
var temp ='';
var humi ='';
var lux ='';
var mdata =[]; // this array stores date and data from multiple sensors
var firstcommaidx = 0;

sp.on('data', function (data) { // call back when data is received
    readData = data.toString(); // append data to buffer
    firstcommaidx = readData.indexOf(','); // string.indexOf(searchvalue,start)

    // parsing data into signals
```

Complete your parser code!!

```
        //console.log(firstcolonidx + "," + readData.indexOf(':', firstcolonidx+1))
        readData = '';

        dStr = getDateString();
        mdata[0]=dStr;   // Date
        mdata[1]=temp;   // temperature data
        mdata[2]=humi;   // humidity data
        mdata[3]=lux;    // luminosity data
        console.log(mdata);
        io.sockets.emit('message', mdata);  // send data to all clients
    } else {  // error
        console.log(readData);
    }
});
```

A5.7.9 DHT22 + CdS + Node.js

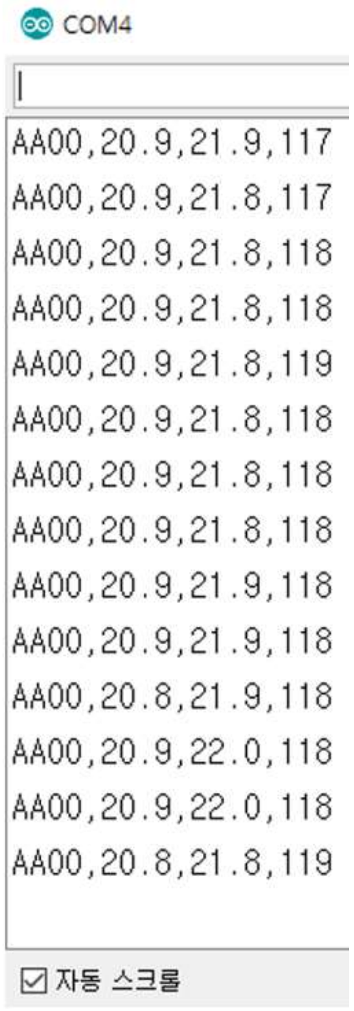
[2.3] NodeJS code: cds_dht22_node.js (Complete your parser code)



```
var readData = '';  // this stores the buffer
var temp ='';
var humi ='';
var lux ='';
var mdata =[]; // this array stores date and data from multiple sensors
var firstcommaidx = 0;

sp.on('data', function (data) { // call back when data is received
    readData = data.toString(); // append data to buffer
    firstcommaidx = readData.indexOf(','); // string.indexOf(searchvalue,start)

    // parsing data into signals
    if (readData.lastIndexOf(',') > firstcommaidx && firstcommaidx > 0) {
        temp = readData.substring(firstcommaidx + 1, readData.indexOf(',',firstcommaidx+1));
        humi = readData.substring(readData.indexOf(',',firstcommaidx+1) + 1, readData.lastIndexOf(','));
        lux = readData.substring(readData.lastIndexOf(',')+1);
        //console.log(firstcolonidx + "," + readData.indexOf(':', firstcolonidx+1))
        readData = '';

        dStr = getDateString();
        mdata[0]=dStr;   // Date
        mdata[1]=temp;   // temperature data
        mdata[2]=humi;   // humidity data
        mdata[3]=lux;    // luminosity data
        console.log(mdata);
        io.sockets.emit('message', mdata);  // send data to all clients
    } else {  // error
        console.log(readData);
    }
});
```

A5.7.10 DHT22 + CdS + Node.js

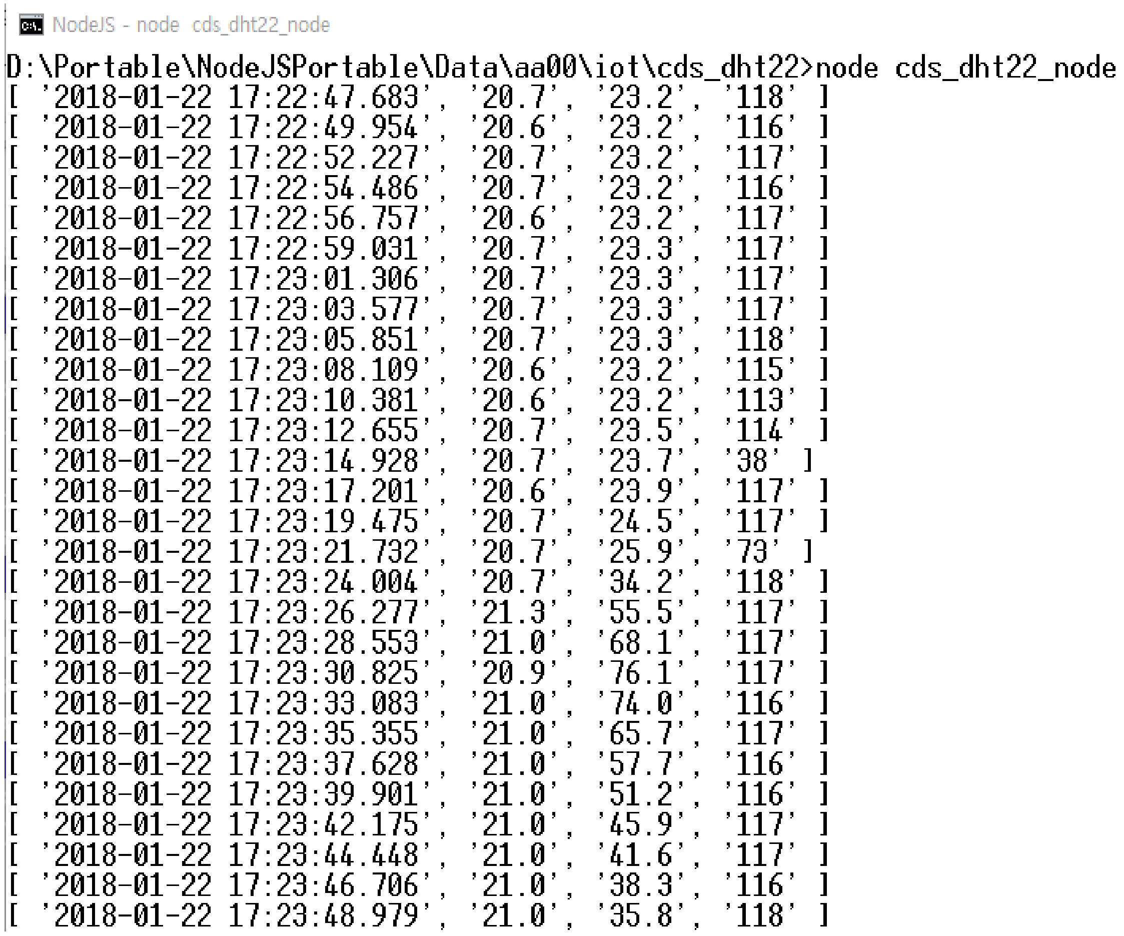
[3] Result: Parsed streaming data from dht22 & CdS (Run in Node cmd)



COM4

```
AA00,20.9,21.9,117
AA00,20.9,21.8,117
AA00,20.9,21.8,118
AA00,20.9,21.8,118
AA00,20.9,21.8,119
AA00,20.9,21.8,118
AA00,20.9,21.8,118
AA00,20.9,21.8,118
AA00,20.9,21.9,118
AA00,20.9,21.9,118
AA00,20.8,21.9,118
AA00,20.9,22.0,118
AA00,20.9,22.0,118
AA00,20.8,21.8,119
```

☑ 자동 스크롤

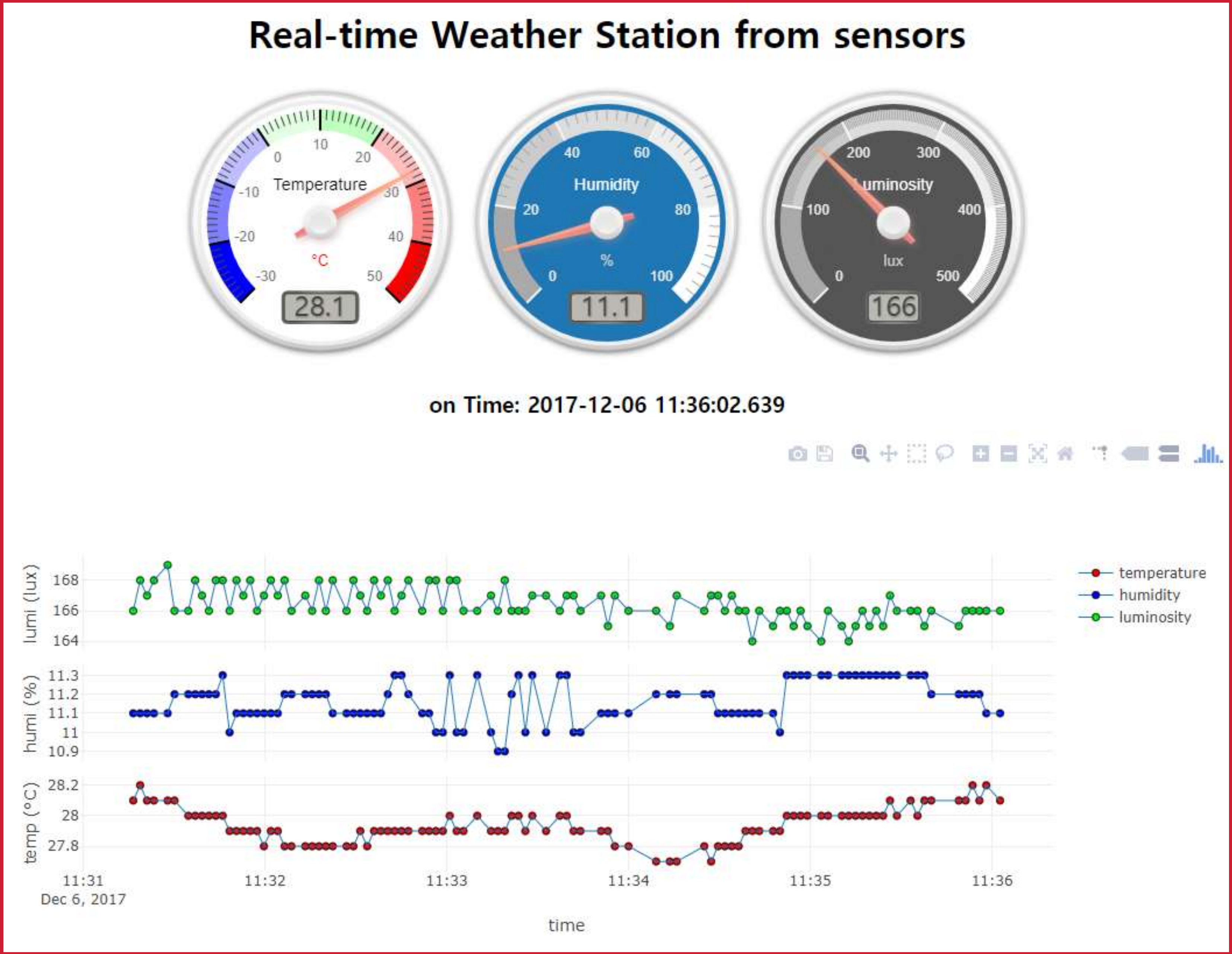


NodeJS - node cds_dht22_node

```
D:\Portable\NodeJSPortable\Data\aa00\iot\cds_dht22>node cds_dht22_node
[ '2018-01-22 17:22:47.683', '20.7', '23.2', '118' ]
[ '2018-01-22 17:22:49.954', '20.6', '23.2', '116' ]
[ '2018-01-22 17:22:52.227', '20.7', '23.2', '117' ]
[ '2018-01-22 17:22:54.486', '20.7', '23.2', '116' ]
[ '2018-01-22 17:22:56.757', '20.6', '23.2', '117' ]
[ '2018-01-22 17:22:59.031', '20.7', '23.3', '117' ]
[ '2018-01-22 17:23:01.306', '20.7', '23.3', '117' ]
[ '2018-01-22 17:23:03.577', '20.7', '23.3', '117' ]
[ '2018-01-22 17:23:05.851', '20.7', '23.3', '118' ]
[ '2018-01-22 17:23:08.109', '20.6', '23.2', '115' ]
[ '2018-01-22 17:23:10.381', '20.6', '23.2', '113' ]
[ '2018-01-22 17:23:12.655', '20.7', '23.5', '114' ]
[ '2018-01-22 17:23:14.928', '20.7', '23.7', '38' ]
[ '2018-01-22 17:23:17.201', '20.6', '23.9', '117' ]
[ '2018-01-22 17:23:19.475', '20.7', '24.5', '117' ]
[ '2018-01-22 17:23:21.732', '20.7', '25.9', '73' ]
[ '2018-01-22 17:23:24.004', '20.7', '34.2', '118' ]
[ '2018-01-22 17:23:26.277', '21.3', '55.5', '117' ]
[ '2018-01-22 17:23:28.553', '21.0', '68.1', '117' ]
[ '2018-01-22 17:23:30.825', '20.9', '76.1', '117' ]
[ '2018-01-22 17:23:33.083', '21.0', '74.0', '116' ]
[ '2018-01-22 17:23:35.355', '21.0', '65.7', '117' ]
[ '2018-01-22 17:23:37.628', '21.0', '57.7', '116' ]
[ '2018-01-22 17:23:39.901', '21.0', '51.2', '116' ]
[ '2018-01-22 17:23:42.175', '21.0', '45.9', '117' ]
[ '2018-01-22 17:23:44.448', '21.0', '41.6', '117' ]
[ '2018-01-22 17:23:46.706', '21.0', '38.3', '116' ]
[ '2018-01-22 17:23:48.979', '21.0', '35.8', '118' ]
```

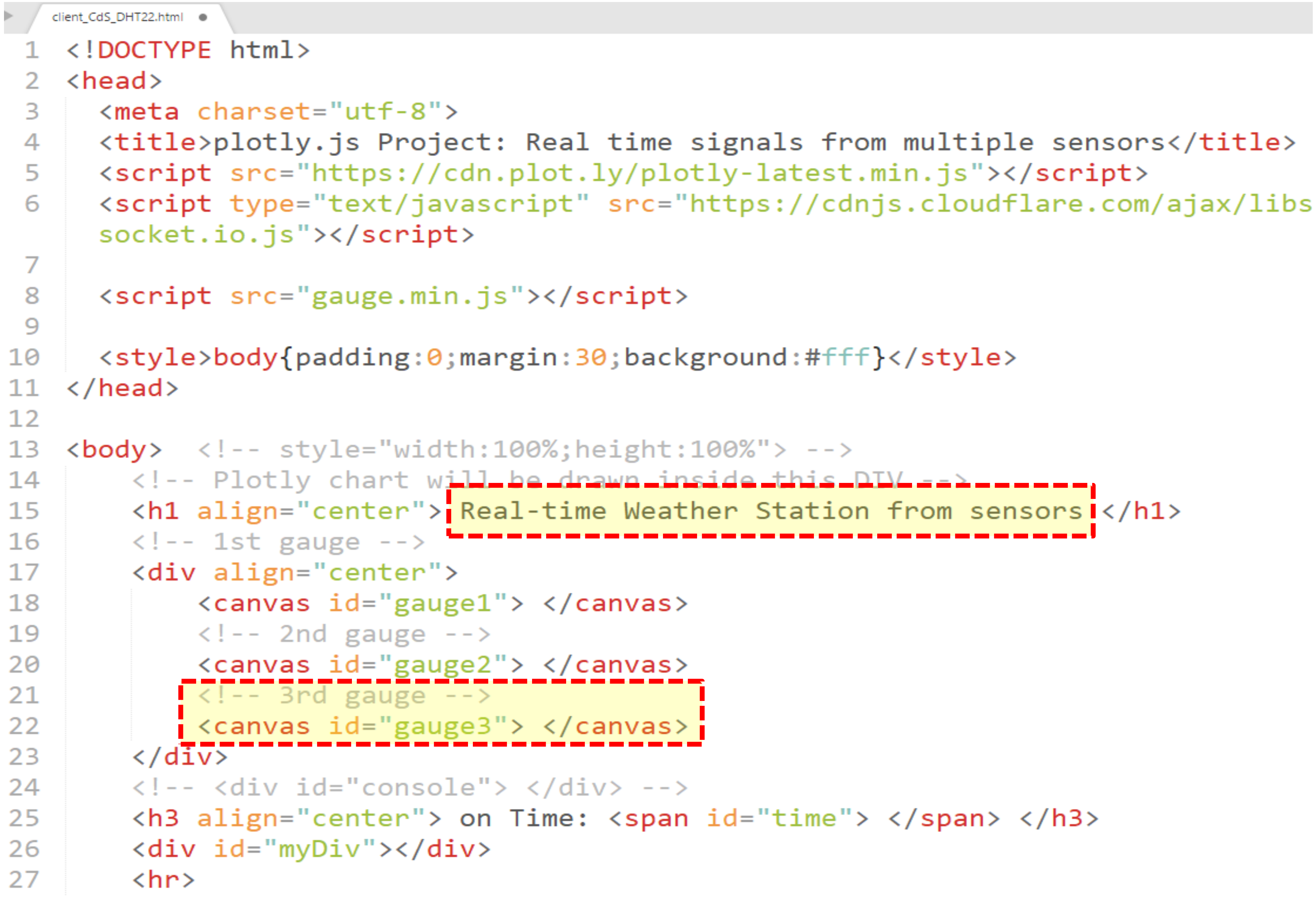
Save as
AAnn_cds_dht22_data.png

WEB client： client_cds_dht22.html



A5.8.1 DHT22 + CdS + Node.js

[4.1] WEB client: client_cds_dht22.html

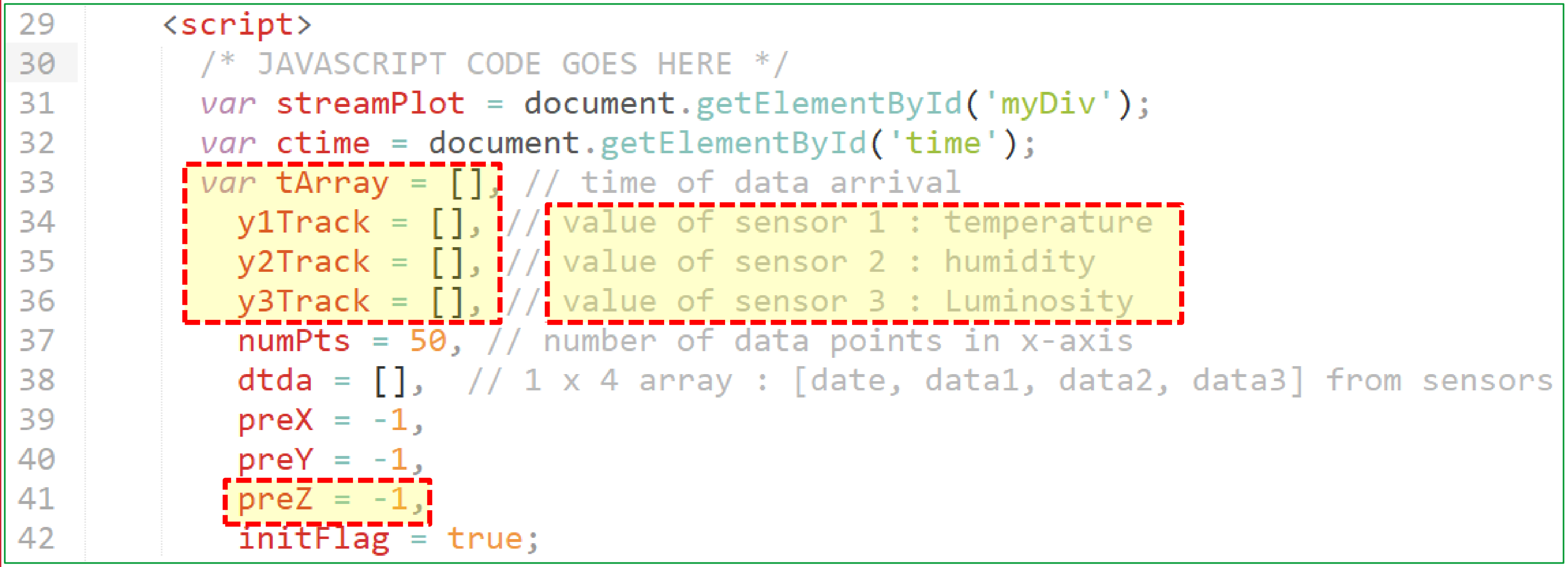


client_CdS_DHT22.html

```html
<!DOCTYPE html>
<head>
  <meta charset="utf-8">
  <title>plotly.js Project: Real time signals from multiple sensors</title>
  <script src="https://cdn.plot.ly/plotly-latest.min.js"></script>
  <script type="text/javascript" src="https://cdnjs.cloudflare.com/ajax/libs
  socket.io.js"></script>

  <script src="gauge.min.js"></script>

  <style>body{padding:0;margin:30;background:#fff}</style>
</head>

<body>  <!-- style="width:100%;height:100%"> -->
    <!-- Plotly chart will be drawn inside this DIV -->
    <h1 align="center">Real-time Weather Station from sensors</h1>
    <!-- 1st gauge -->
    <div align="center">
        <canvas id="gauge1"> </canvas>
        <!-- 2nd gauge -->
        <canvas id="gauge2"> </canvas>
        <!-- 3rd gauge -->
        <canvas id="gauge3"> </canvas>
    </div>
    <!-- <div id="console"> </div> -->
    <h3 align="center"> on Time: <span id="time"> </span> </h3>
    <div id="myDiv"></div>
    <hr>
```

A5.8.2 DHT22 + CdS + Node.js

[4.2] WEB client: client_cds_dht22.html



```
    <script>
      /* JAVASCRIPT CODE GOES HERE */
      var streamPlot = document.getElementById('myDiv');
      var ctime = document.getElementById('time');
      var tArray = [], // time of data arrival
        y1Track = [], // value of sensor 1 : temperature
        y2Track = [], // value of sensor 2 : humidity
        y3Track = [], // value of sensor 3 : Luminosity
        numPts = 50, // number of data points in x-axis
        dtda = [],  // 1 x 4 array : [date, data1, data2, data3] from sensors
        preX = -1,
        preY = -1,
        preZ = -1,
        initFlag = true;
```

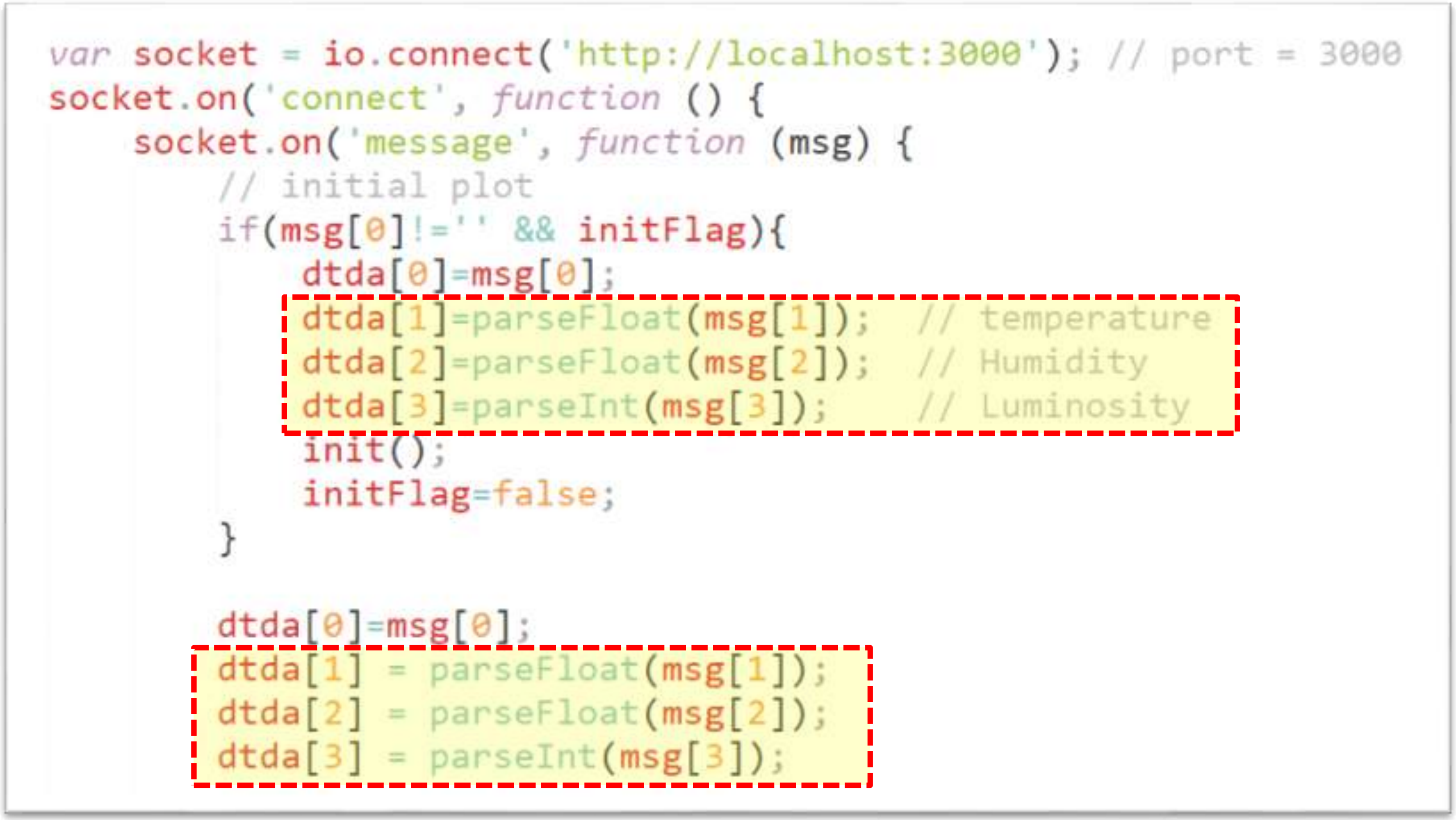
Check points: tArray

xTrack → y1Track, yTrack → y2Track

& add y3Track & preZ

A5.8.3 DHT22 + CdS + Node.js

[4.3] WEB client: client_cds_dht22.html



```
var socket = io.connect('http://localhost:3000'); // port = 3000
socket.on('connect', function () {
    socket.on('message', function (msg) {
        // initial plot
        if(msg[0]!='' && initFlag){
            dtda[0]=msg[0];
            dtda[1]=parseFloat(msg[1]);   // temperature
            dtda[2]=parseFloat(msg[2]);   // Humidity
            dtda[3]=parseInt(msg[3]);     // Luminosity
            init();
            initFlag=false;
        }

        dtda[0]=msg[0];
        dtda[1] = parseFloat(msg[1]);
        dtda[2] = parseFloat(msg[2]);
        dtda[3] = parseInt(msg[3]);
```

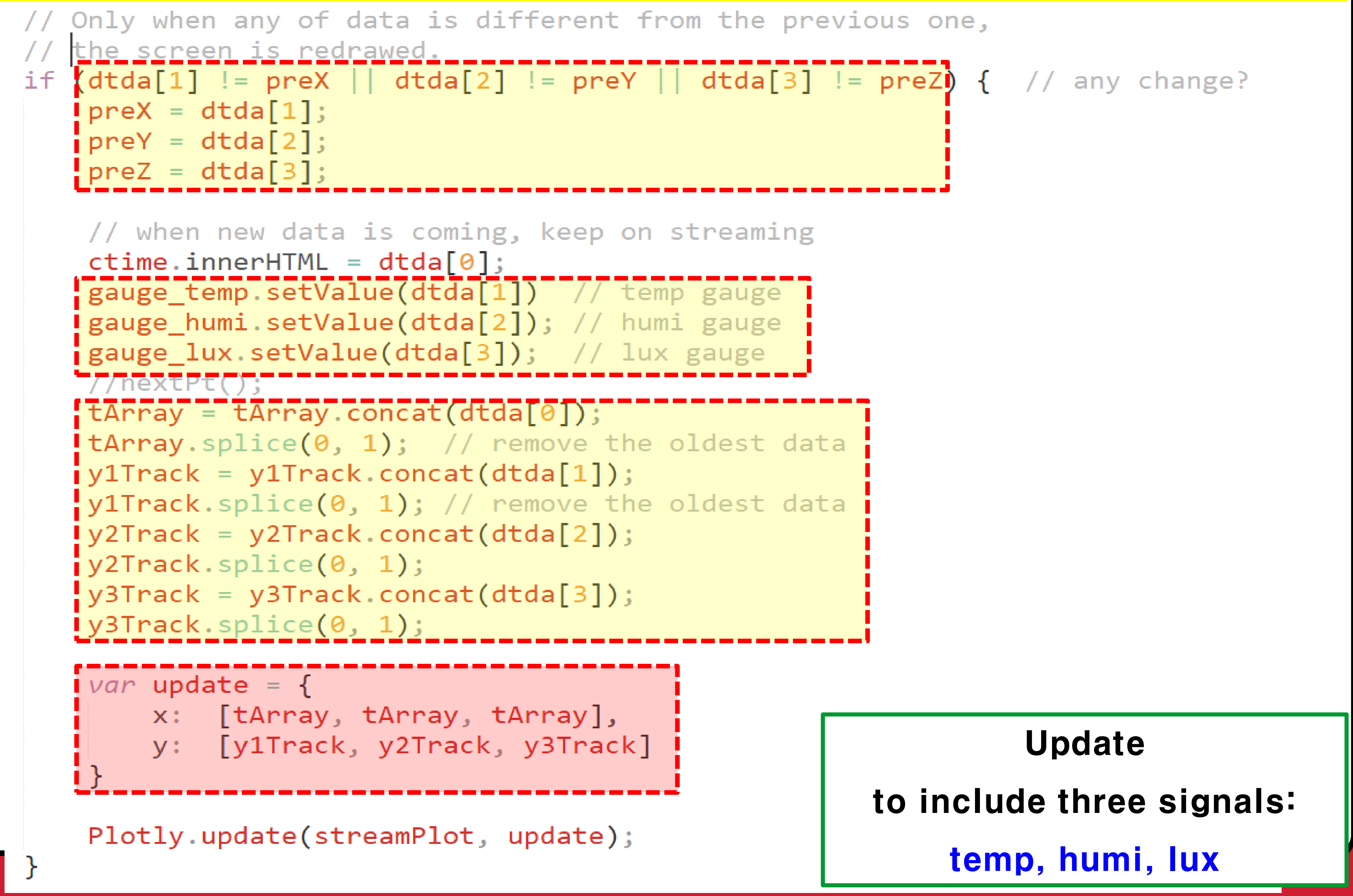
Update

to include three signals:

temp, humi, lux

A5.8.4 DHT22 + CdS + Node.js

[4.4] WEB client: client_cds_dht22.html



```
// Only when any of data is different from the previous one,
// the screen is redrawed.
if (dtda[1] != preX || dtda[2] != preY || dtda[3] != preZ) {  // any change?
    preX = dtda[1];
    preY = dtda[2];
    preZ = dtda[3];

    // when new data is coming, keep on streaming
    ctime.innerHTML = dtda[0];
    gauge_temp.setValue(dtda[1])  // temp gauge
    gauge_humi.setValue(dtda[2]); // humi gauge
    gauge_lux.setValue(dtda[3]);  // lux gauge
    //nextPt();
    tArray = tArray.concat(dtda[0]);
    tArray.splice(0, 1);  // remove the oldest data
    y1Track = y1Track.concat(dtda[1]);
    y1Track.splice(0, 1); // remove the oldest data
    y2Track = y2Track.concat(dtda[2]);
    y2Track.splice(0, 1);
    y3Track = y3Track.concat(dtda[3]);
    y3Track.splice(0, 1);

    var update = {
        x:  [tArray, tArray, tArray],
        y:  [y1Track, y2Track, y3Track]
    }

    Plotly.update(streamPlot, update);
}
```

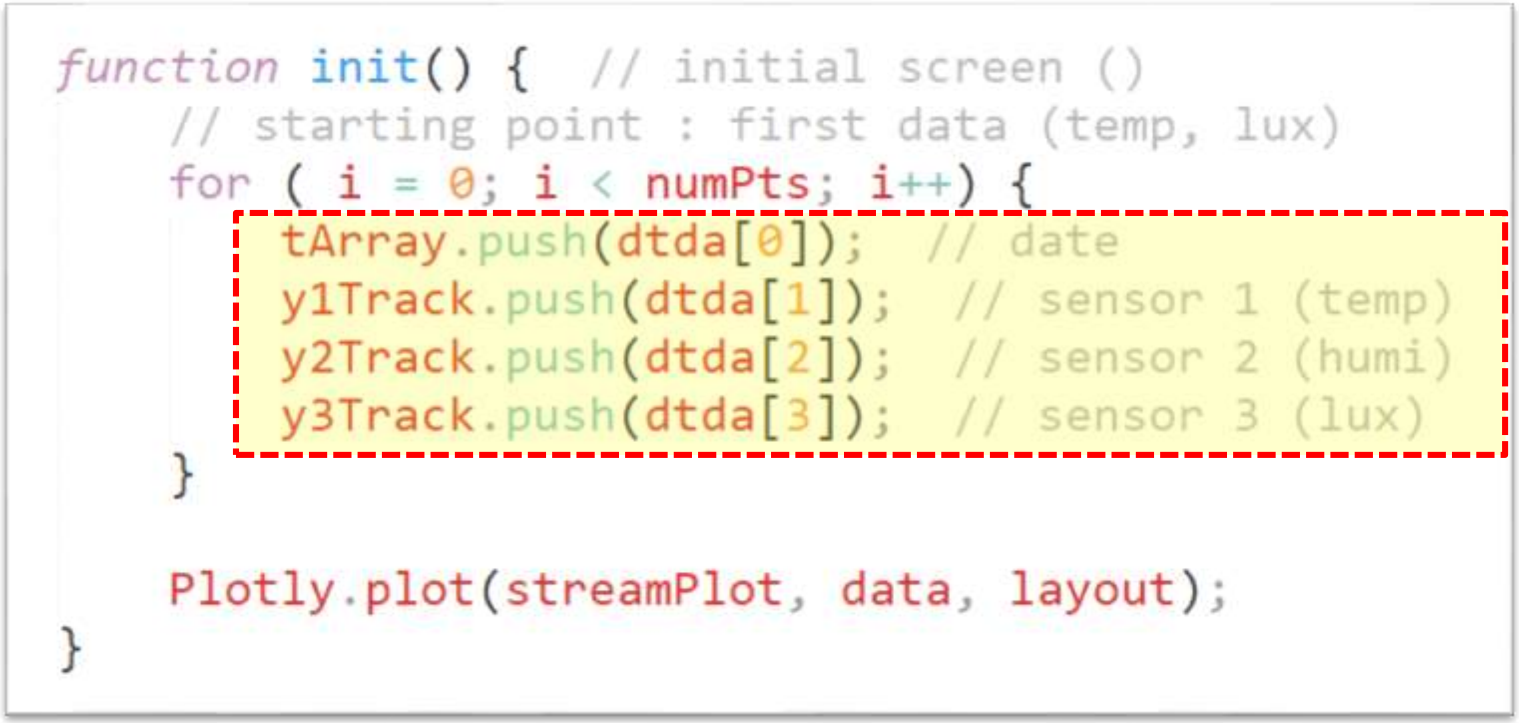
Update

to include three signals:

temp, humi, lux

A5.8.5 DHT22 + CdS + Node.js

[4.5] WEB client: client_dht22_ldr.html → init()



```
function init() {  // initial screen ()
    // starting point : first data (temp, lux)
    for ( i = 0; i < numPts; i++) {
        tArray.push(dtda[0]);  // date
        y1Track.push(dtda[1]);  // sensor 1 (temp)
        y2Track.push(dtda[2]);  // sensor 2 (humi)
        y3Track.push(dtda[3]);  // sensor 3 (lux)
    }

    Plotly.plot(streamPlot, data, layout);
}
```

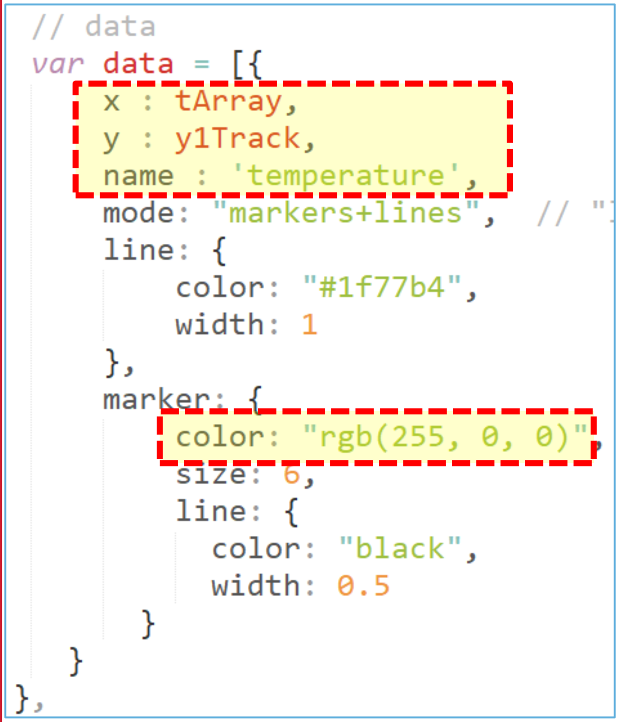
Update

to include three signals:

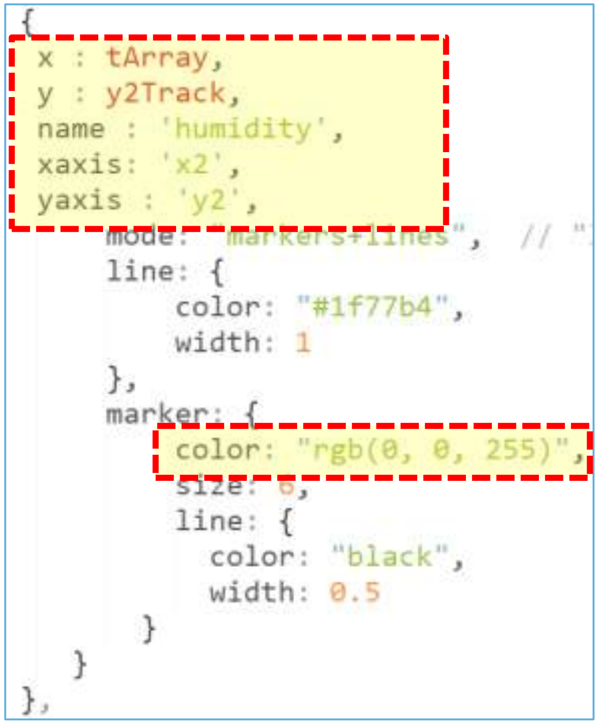
temp, humi, lux

A5.8.6 DHT22 + CdS + Node.js

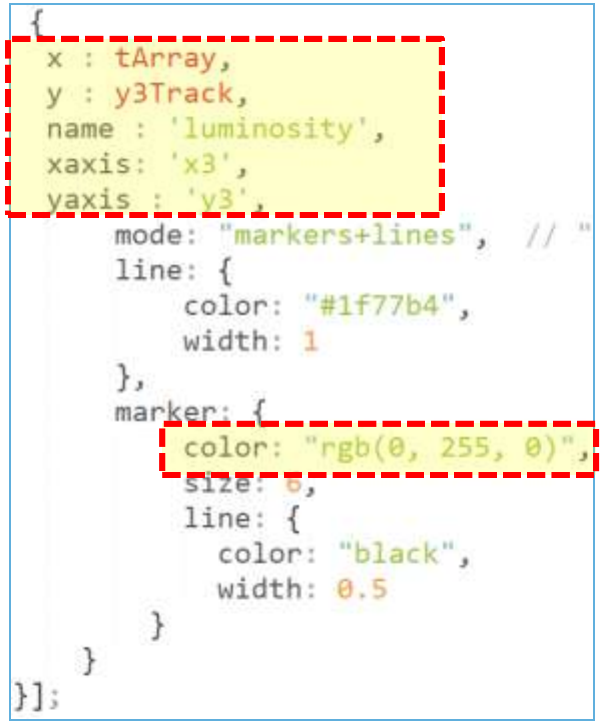
[4.6] WEB client: client_cds_dht22.html - data



```
// data
var data = [{
    x : tArray,
    y : y1Track,
    name : 'temperature',
    mode: "markers+lines",   // "
    line: {
        color: "#1f77b4",
        width: 1
    },
    marker: {
        color: "rgb(255, 0, 0)",
        size: 6,
        line: {
          color: "black",
          width: 0.5
        }
    }
},
```



```
{
    x : tArray,
    y : y2Track,
    name : 'humidity',
    xaxis: 'x2',
    yaxis : 'y2',
    mode: "markers+lines",   // "
    line: {
        color: "#1f77b4",
        width: 1
    },
    marker: {
        color: "rgb(0, 0, 255)",
        size: 6,
        line: {
          color: "black",
          width: 0.5
        }
    }
},
```



```
{
    x : tArray,
    y : y3Track,
    name : 'luminosity',
    xaxis: 'x3',
    yaxis : 'y3',
    mode: "markers+lines",   // "
    line: {
        color: "#1f77b4",
        width: 1
    },
    marker: {
        color: "rgb(0, 255, 0)",
        size: 6,
        line: {
          color: "black",
          width: 0.5
        }
    }
}];
```

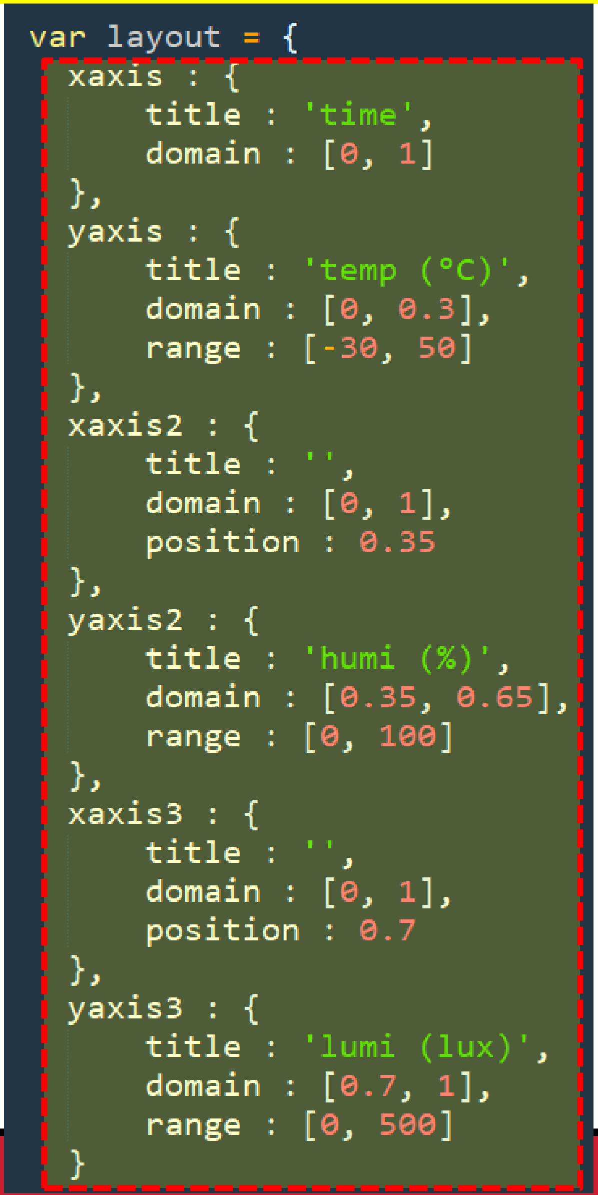
Update data

to include three signals:

temp, humi, lux

A5.8.7 DHT22 + CdS + Node.js

[4.7] WEB client: client_cds_dht22.html - layout



```
var layout = {
    xaxis : {
        title : 'time',
        domain : [0, 1]
    },
    yaxis : {
        title : 'temp (°C)',
        domain : [0, 0.3],
        range : [-30, 50]
    },
    xaxis2 : {
        title : '',
        domain : [0, 1],
        position : 0.35
    },
    yaxis2 : {
        title : 'humi (%)',
        domain : [0.35, 0.65],
        range : [0, 100]
    },
    xaxis3 : {
        title : '',
        domain : [0, 1],
        position : 0.7
    },
    yaxis3 : {
        title : 'lumi (lux)',
        domain : [0.7, 1],
        range : [0, 500]
    }
```

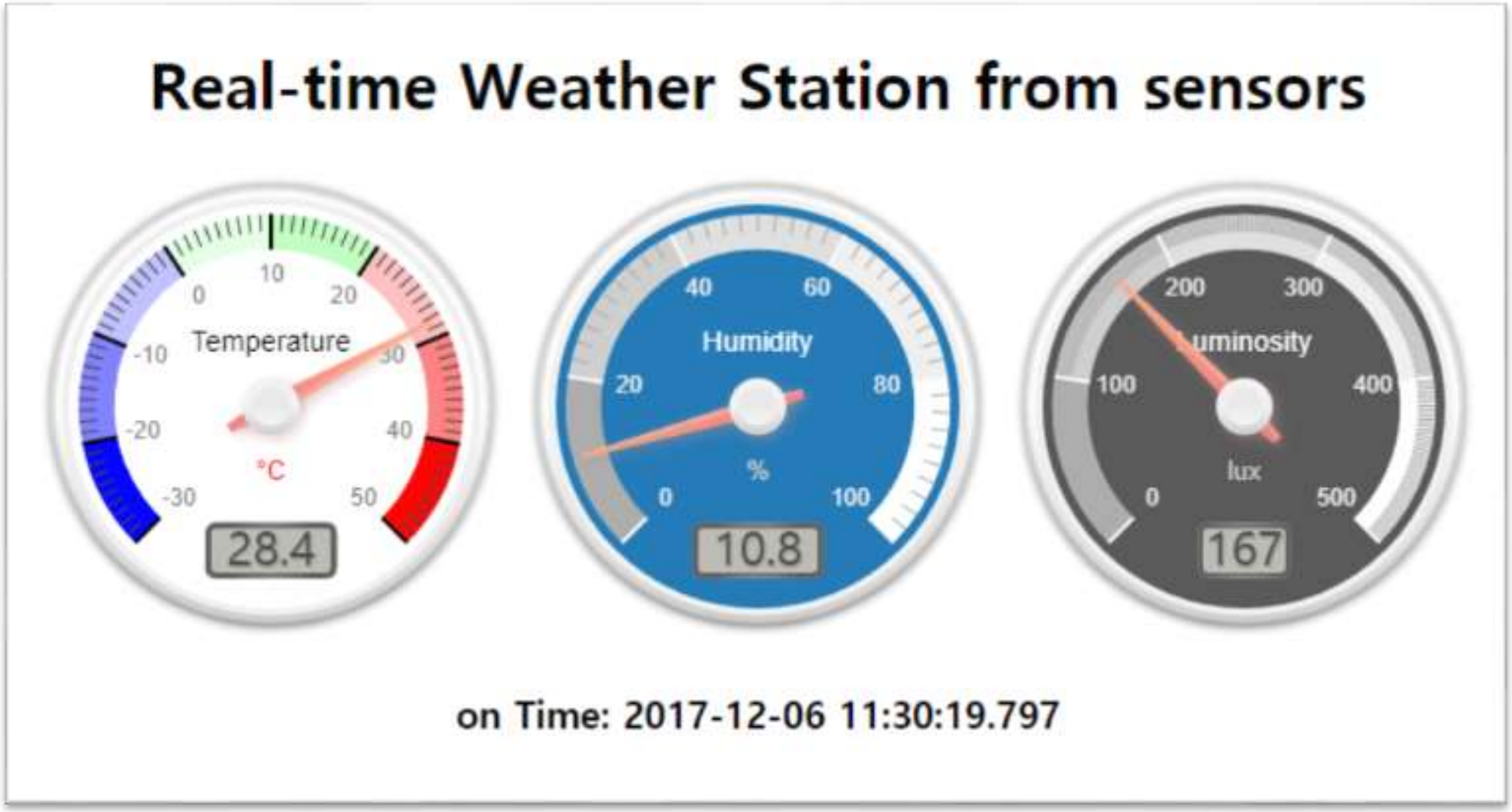
1. Update layout
   to include three signals:
   temp, humi, lux.

2. Check the domain &
   position.

Save the complete code as AAnn_cds_dht22.html

A5.8.8 DHT22 + CdS + Node.js

[4.8] WEB client: client_dht22_ldr.html – Design your gauges


Real-time Weather Station from sensors

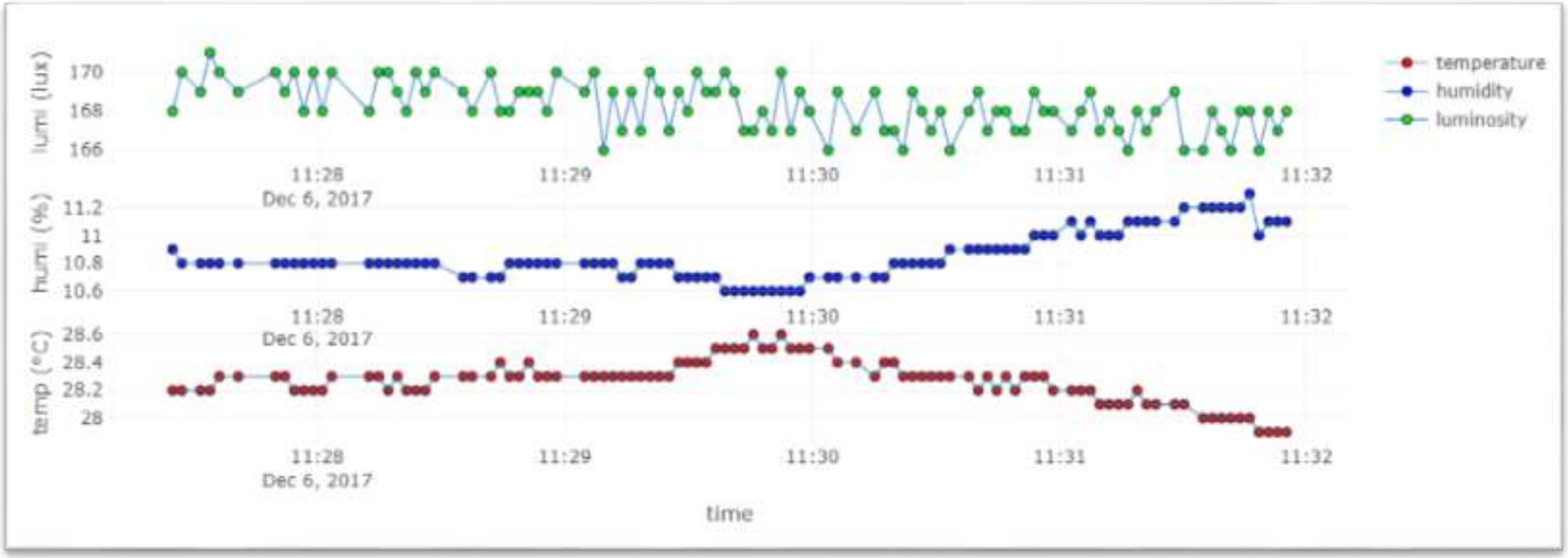
on Time: 2017-12-06 11:30:19.797

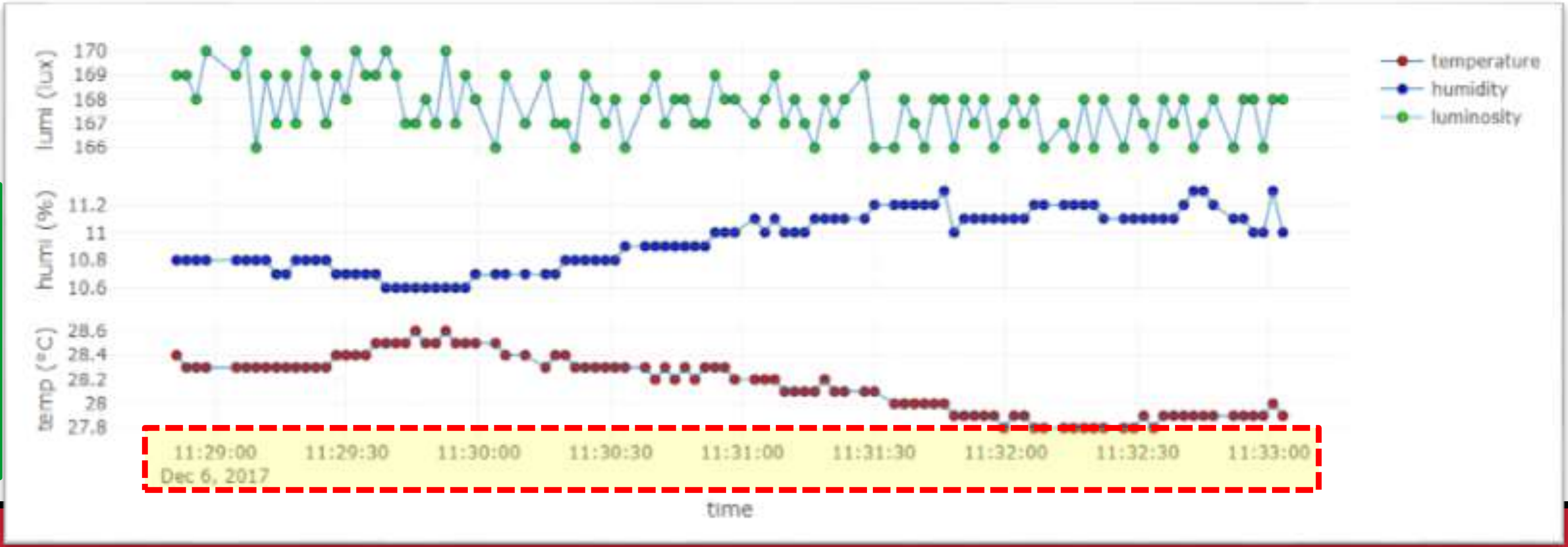
Save the complete code as

AAnn_cds_dht22.html

A5.8.9 DHT22 + CdS + Node.js

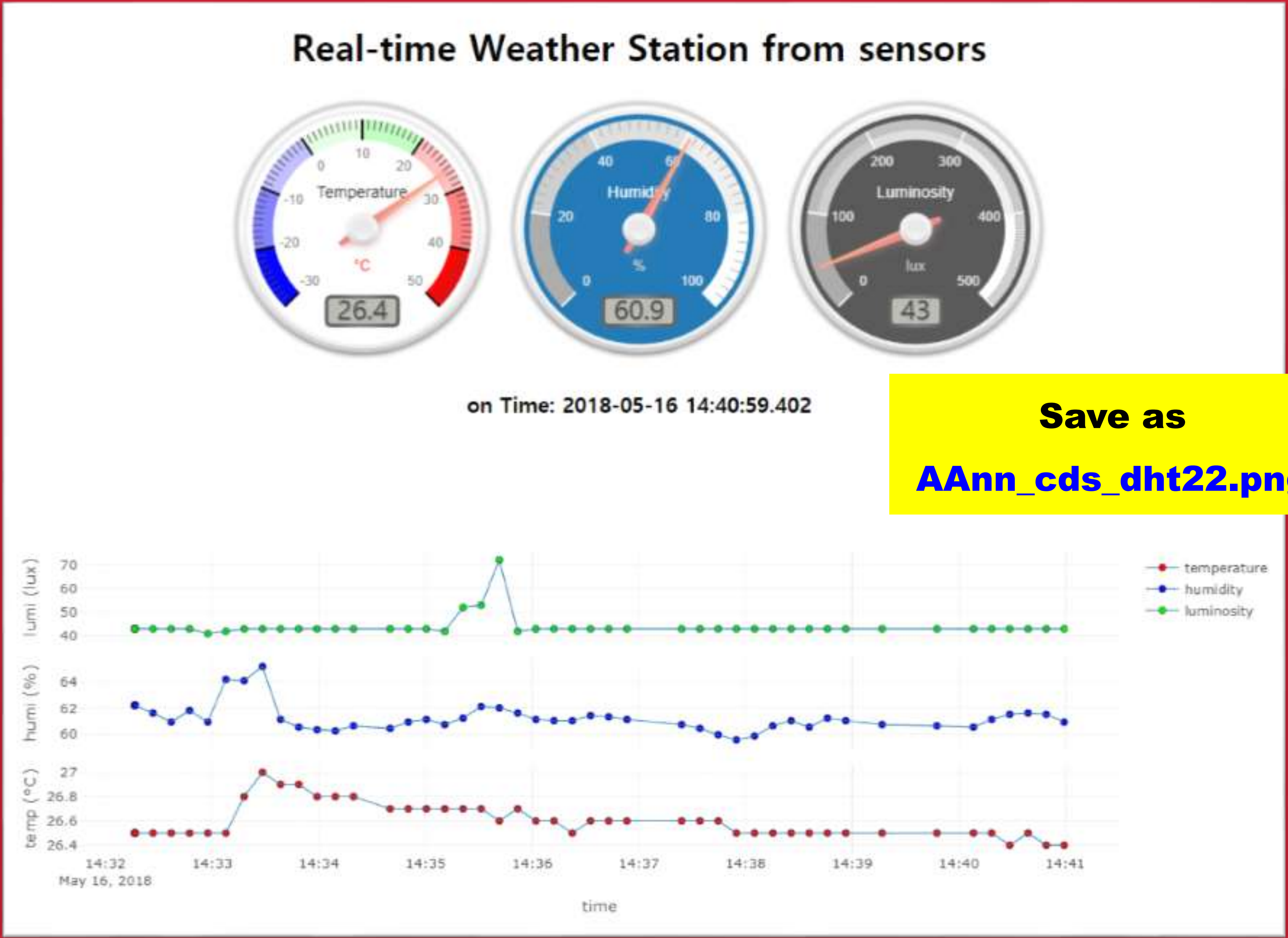
[4.9] WEB client: Design layout (show date at lower axis)





[Hint]

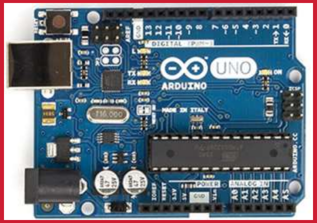
Plot.ly


Real-time Weather Station from sensors

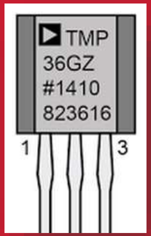
on Time: 2018-05-16 14:40:59.402

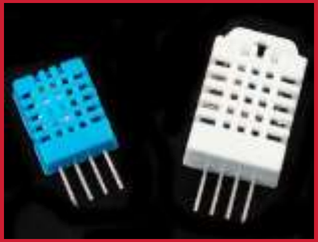
Save as

AAnn_cds_dht22.png



[Practice]





◆ [wk11]

- RT Data Visualization with node.js
- Multiple data and Usage of gauge.js
- Complete your real-time WEB charts
- Upload file name : AAnn_Rpt09

wk11 : Practice : AAnn_Rpt09

- **[Target of this week]**
  - Complete your works
  - **Save your outcomes and upload outputs in github**

제출폴더명 : **AAnn_Rpt09**

- 압축할 파일들

① **AAnn_DS_cds_tmp36.png**

② **AAnn_cds_dht22_data.png**

③ **AAnn_cds_dht22.html**

④ **AAnn_cds_dht22.png**

⑤ **All *.ino**

⑥ **All *.js**

⑦ **All *.html**

[Upload to github]

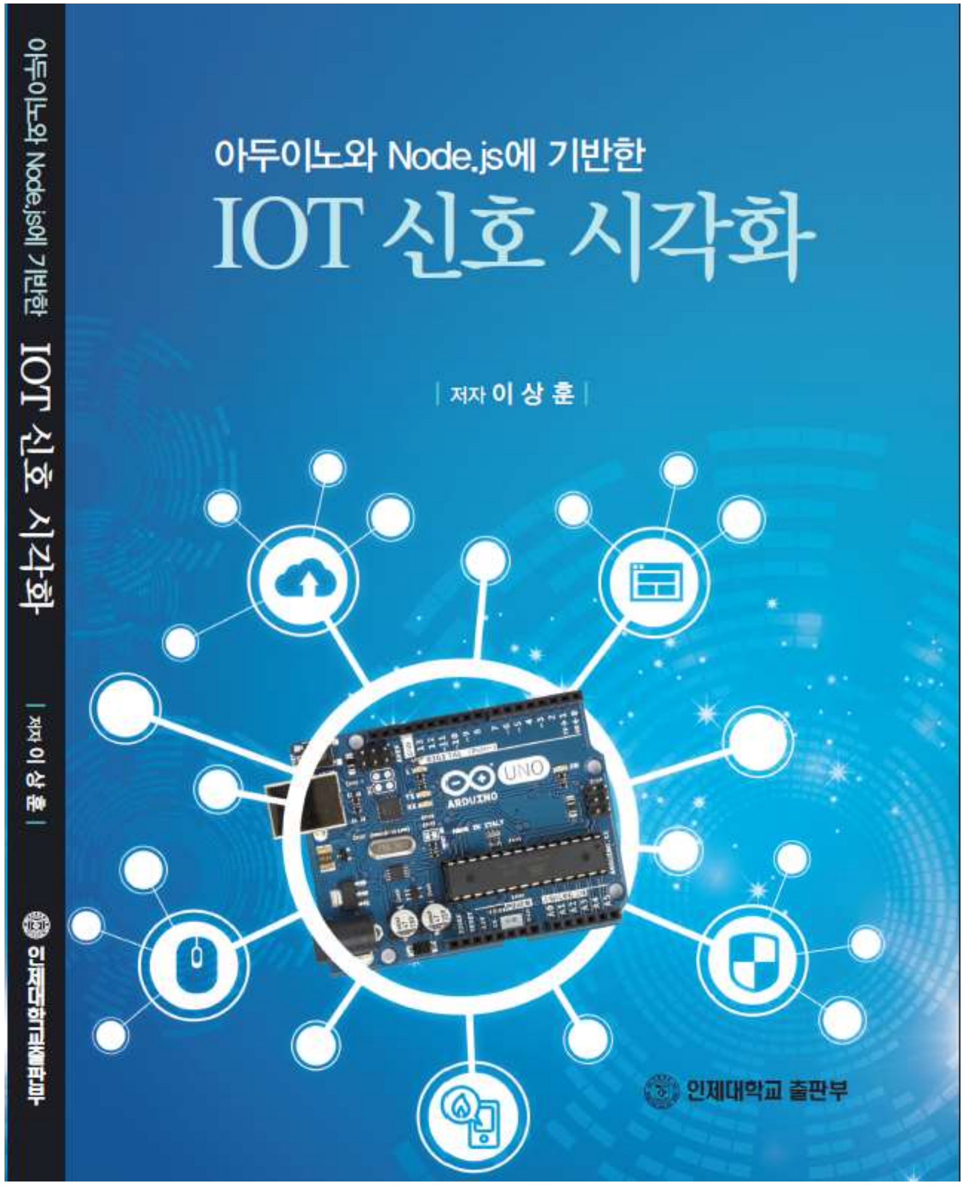
- [wk11]
  - upload all work of this week
  - Use repo “aann” in github
  - upload folder “aann_rpt09” in your github.

Lecture materials

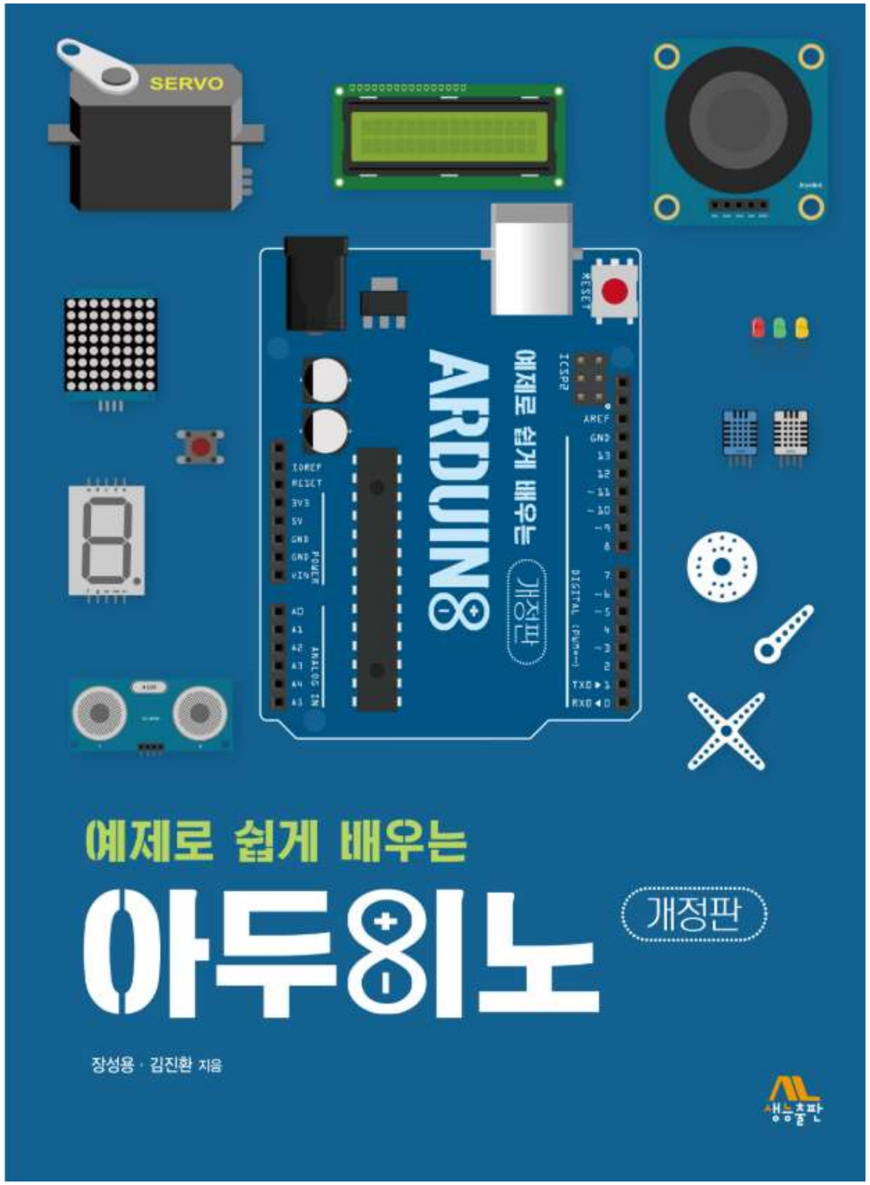
- **References & good sites**

  - ✓ http://www.arduino.cc Arduino Homepage
  - ✓ http://www.nodejs.org/ko Node.js
  - ✓ https://plot.ly/ plotly
  - ✓ https://www.mongodb.com/ MongoDB
  - ✓ http://www.w3schools.com By w3schools
  - ✓ http://www.github.com GitHub

주교재 및 참고도서

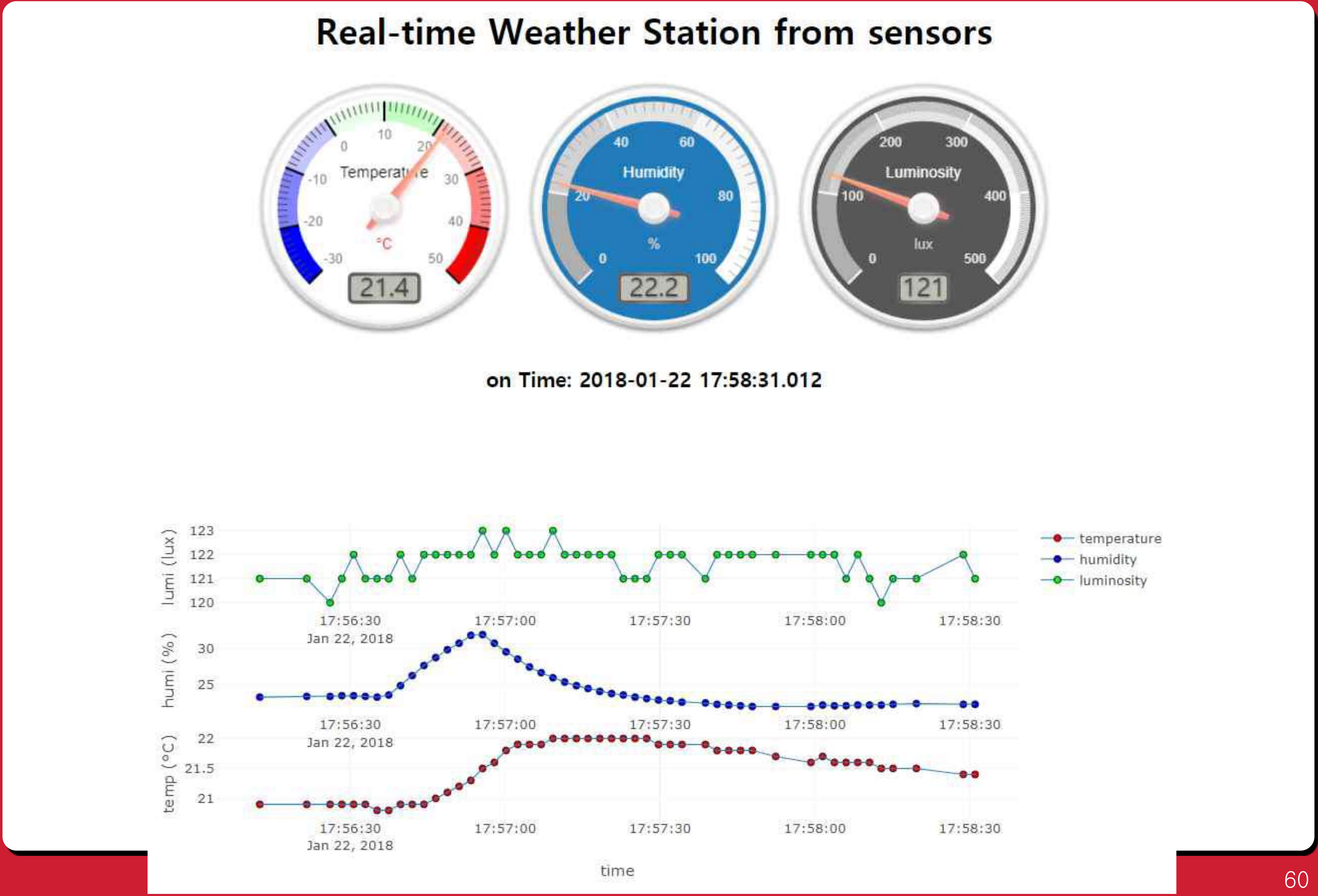


아두이노와 Node.js에 기반한
IOT 신호 시각화
| 저자 이 상 훈 |
인제대학교 출판부



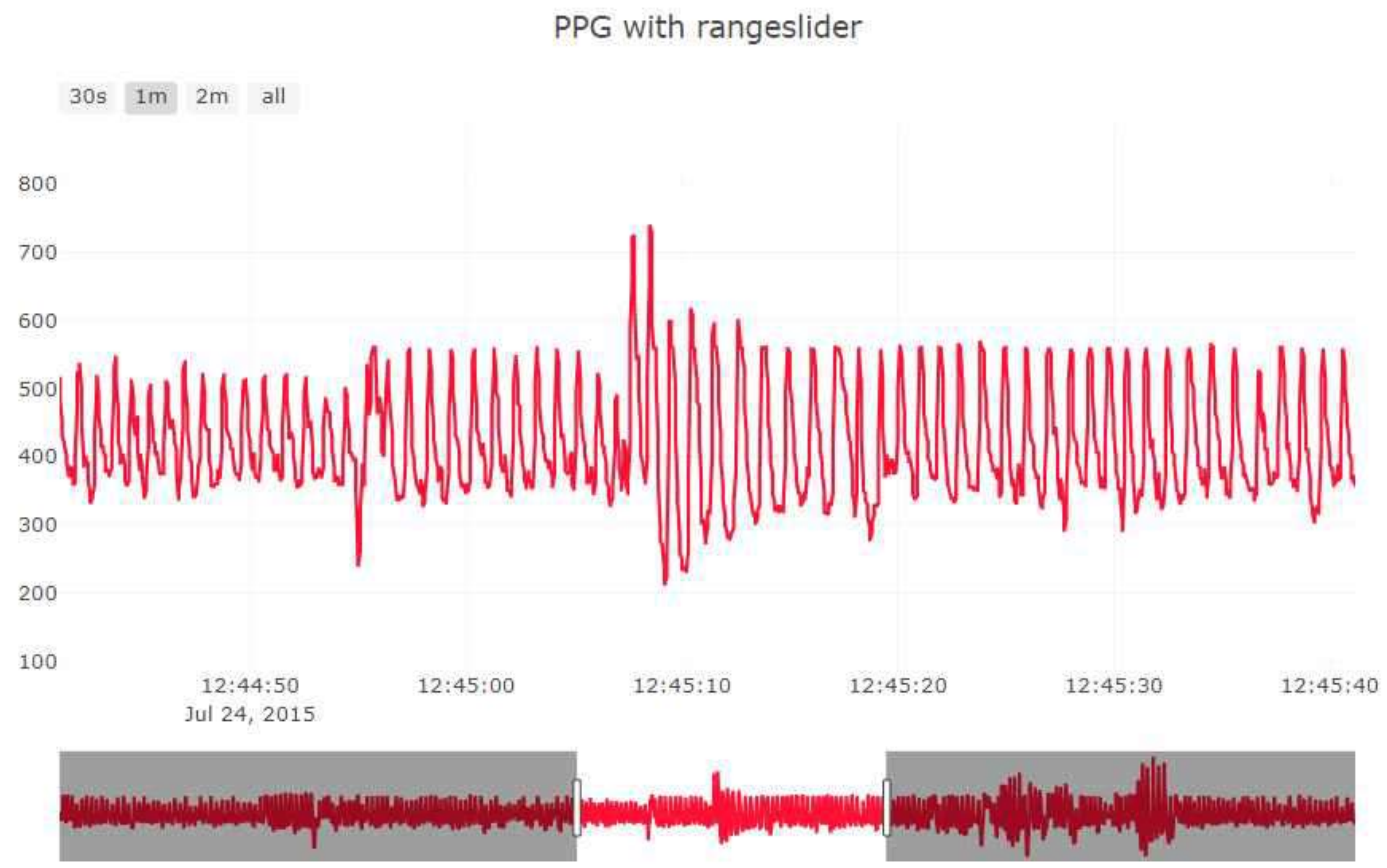
예제로 쉽게 배우는
아두이노 개정판
장성용 · 김진환 지음
생능출판

Target of this class


Real-time Weather Station from sensors

on Time: 2018-01-22 17:58:31.012

Another target of this class


PPG with rangeslider
30s
1m
2m
all
12:44:50
Jul 24, 2015
12:45:00
12:45:10
12:45:20
12:45:30
12:45:40