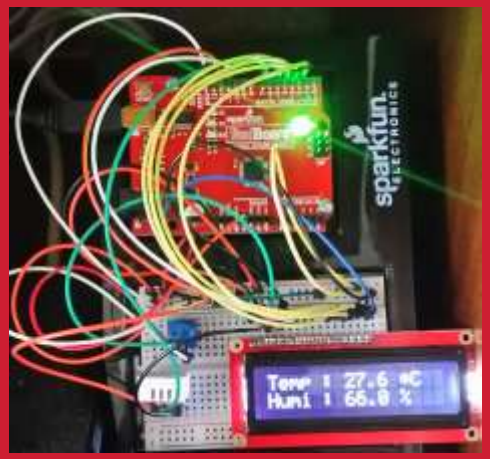
Healthcare-IOT
[wk10]



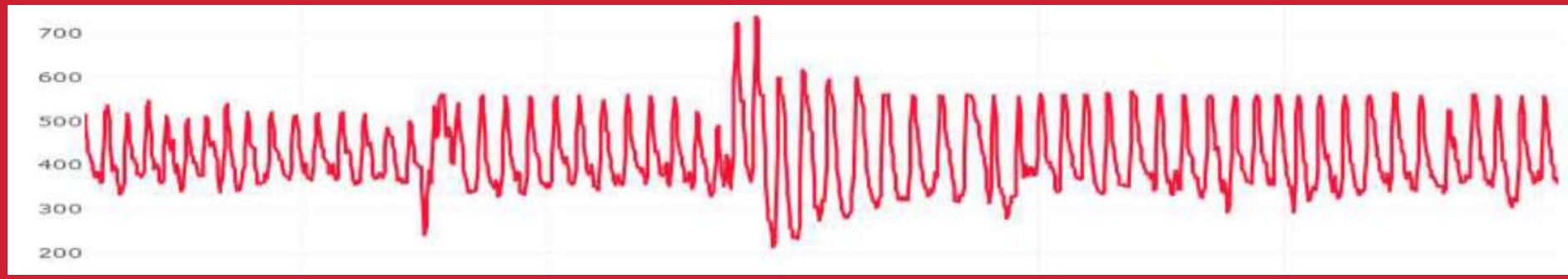
Data visualization using plotly.js II.

Visualization of Healthcare Signals using Arduino & Node.js

HCit, INJE University

1st semester, 2018

Email : chaos21c@gmail.com



My ID

오전

성명	ID
김민선	HS01
김영걸	HS02
김주란	HS03
김주현	HS04
김태민	HS05
여준하	HS06
이수민	HS07
정민지	HS08
정유현	HS09
정재은	HS10
주하영	HS11
한준영	HS12

오후

성명	ID
신영주	HS21
오가영	HS22
윤민수	HS23
윤진아	HS24
이진영	HS25
임상은	HS26
임재형	HS27
최민영	HS28
황유빈	HS29

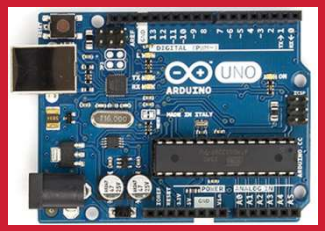
주간계획서

주간계획서			
주차	수업방법	수업내용	과제물
1	강의/실습	수업 및 실습 안내 -포터블 소프트웨어 설치	
2	강의/실습	Node.js I - Node.js 코드의 기본 구조 - 기초 Node 서버 및 클라이언트	실습확인
3	강의/실습	Node.js II - Node.js Express 서버	실습확인
4	강의/실습/발표	Arduino I - 아날로그 신호 회로 - LCD를 이용한 센서 신호 모니터링	실습확인
5	강의/실습	Arduino II - 단일 센서 회로와 Node.js 연결 - 다중 센서 회로와 Node.js 연결	실습확인
6	강의/실습	프로젝트1 - 생체 센서 회로와 Node.js 연결 - 생체 신호 소개	프로젝트1
7	강의/실습/발표	IOT 데이터 시각화 I (Plotly.js) - 데이터 및 시계열 차트 - 데이터 스트리밍	실습확인
8	시험	중간고사	
9	강의/실습	IOT 데이터 시각화 II (Plotly.js) - 다중 센서 데이터 시각화 - 다중 센서 데이터 스트리밍	실습확인
10	강의/실습/발표	프로젝트II - 생체 센서 데이터 시각화 - 생체 센서 데이터 스트리밍	프로젝트II
11	강의/실습	IOT 데이터 저장과 처리 - MongoDB 설치 및 Mongo shell - MongoDB와 Node.js 연결 및 데이터 저장	실습확인
12	강의/실습	프로젝트III - MongoDB에 IOT 데이터 저장 및 모니터링 - 생체 센서 데이터 저장 및 시각화	프로젝트III
13	강의/실습	IOT 데이터 마이닝 - 아두이노에서 발생된 데이터 관리 - 데이터마이닝 소개	실습확인
14	강의/실습/발표	프로젝트IV - 생체 센서 데이터 관리 - 생체 센서 데이터 마이닝	프로젝트IV
15	시험	기말고사	

Purpose of HS

주요 수업 목표는 다음과 같다.

1. Node.js를 이용한 아두이노 센서 신호 처리
2. Plotly.js를 이용한 아두이노 센서 신호 시각화
3. MongoDB에 아두이노 센서 데이터 저장 및 처리
4. 생체 센서 발생 신호 처리, 시각화 및 저장
5. 생체 센서 발생 신호 저장 및 분석
6. 생체 신호 장비 활용 능력



[Review]

- [wk09]
  - Charts by plotly
  - Complete your plotly chart project
  - Upload file name : HSnn_Rpt07.zip

[wk09] Practice-07 HSnn_Rpt07.zip

- [Target of this week]
  - Complete your charts
  - Save your outcomes and compress them.

제출파일명 : **HSnn_Rpt07.zip**

- 압축할 파일들

① HSnn_Chart_Layout.png

② HSnn_Plot_Style.png

③ HSnn_Axis_Title.png

④ HSnn_Line_Dash_Dot.png

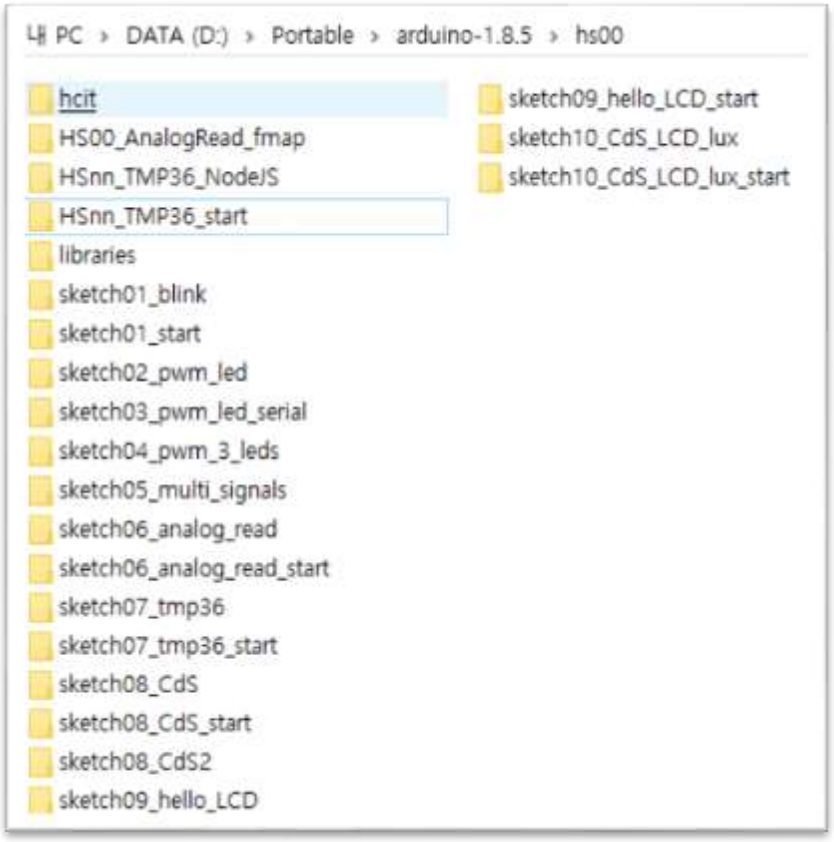
⑤ HSnn_lux_Time_Series.png

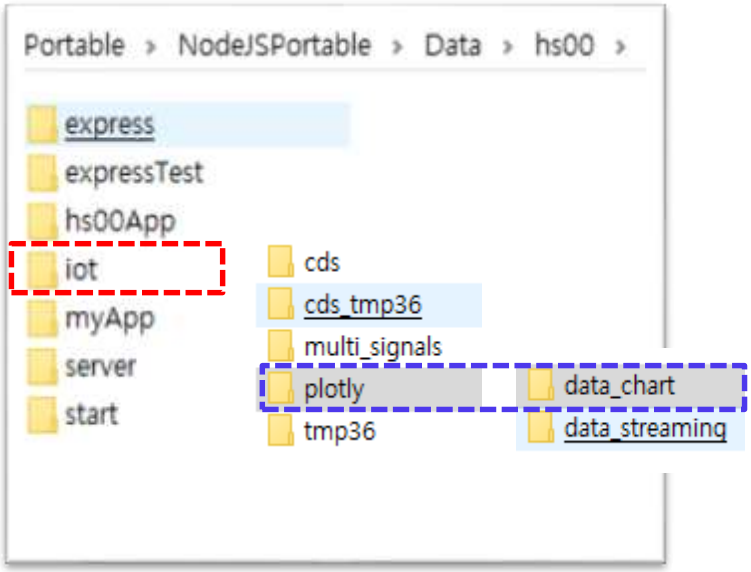
⑥ HSnn_lux_Rangeslider.png

Email : chaos21c@gmail.com

[제목 : id, 이름 (수정)]

[My working folder – wk09]

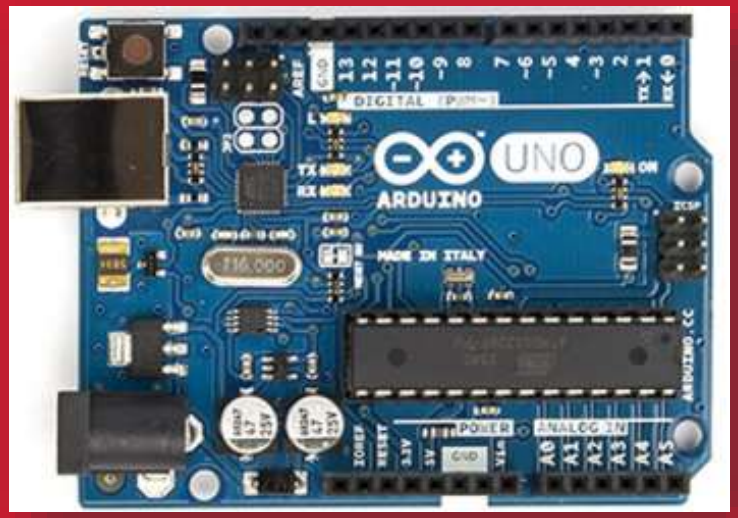


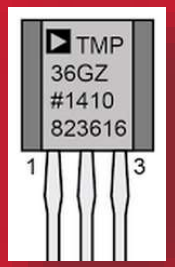


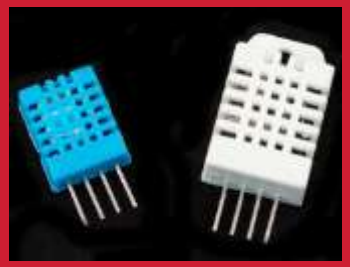
Arduino

+ Node.js

+ plotly.js







IOT: HSC

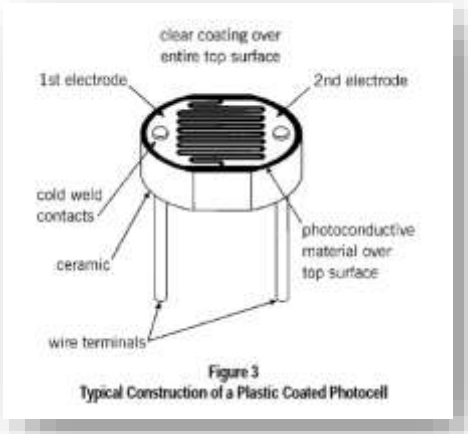
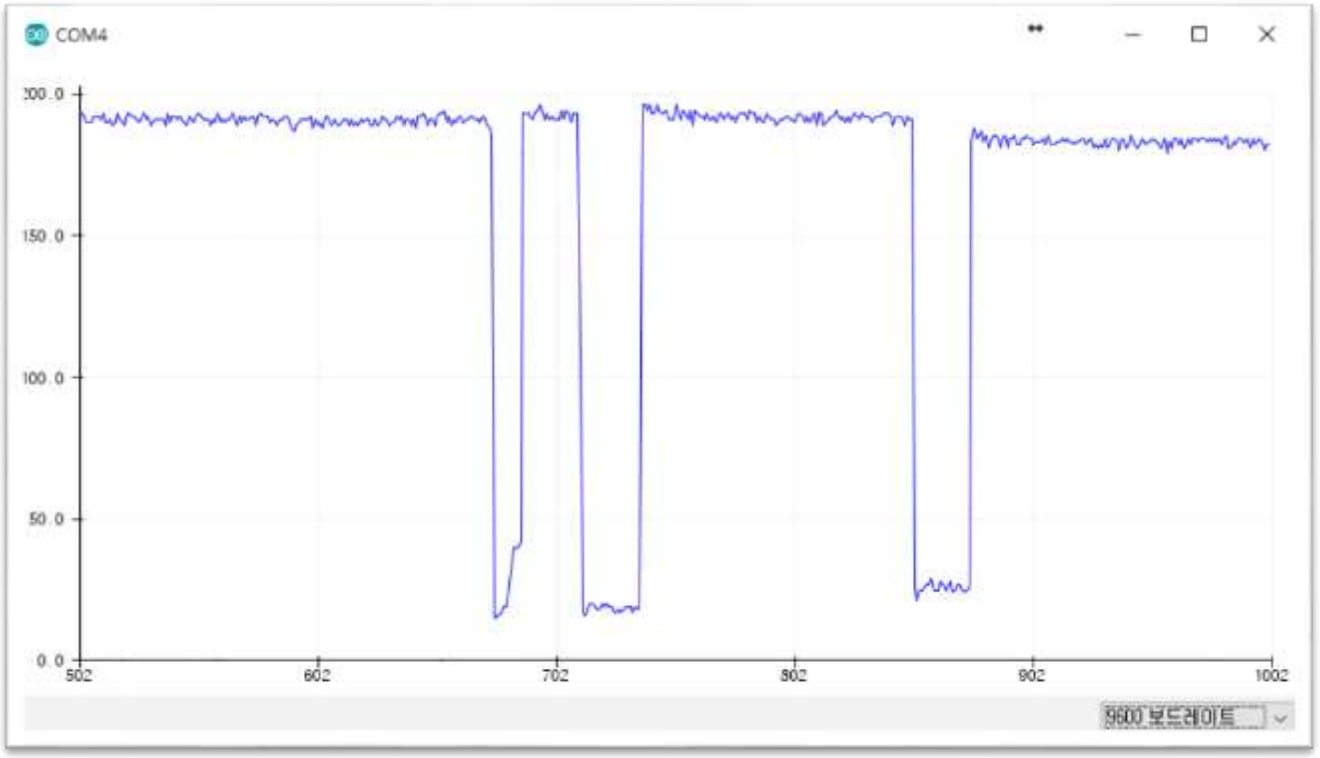
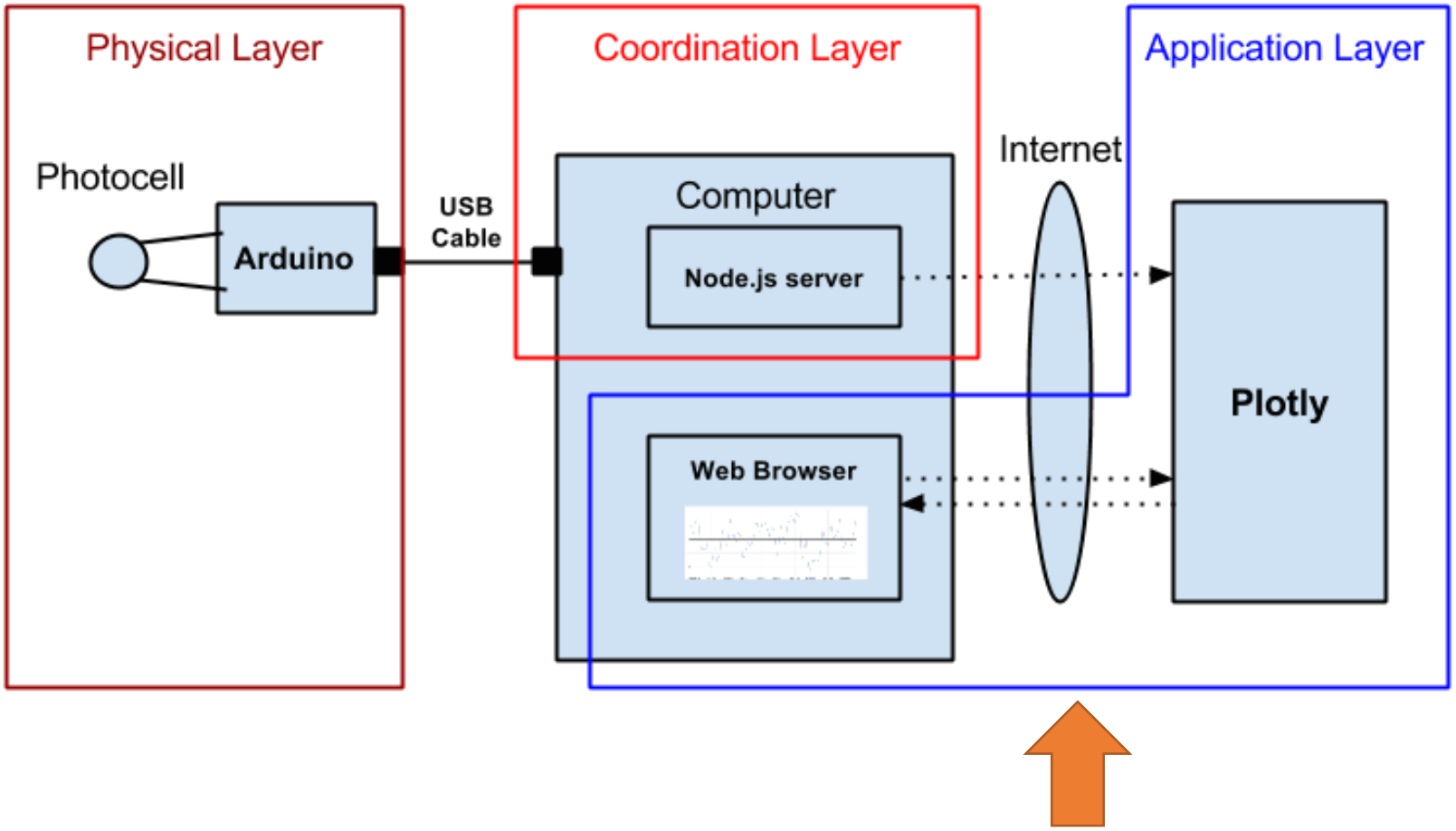


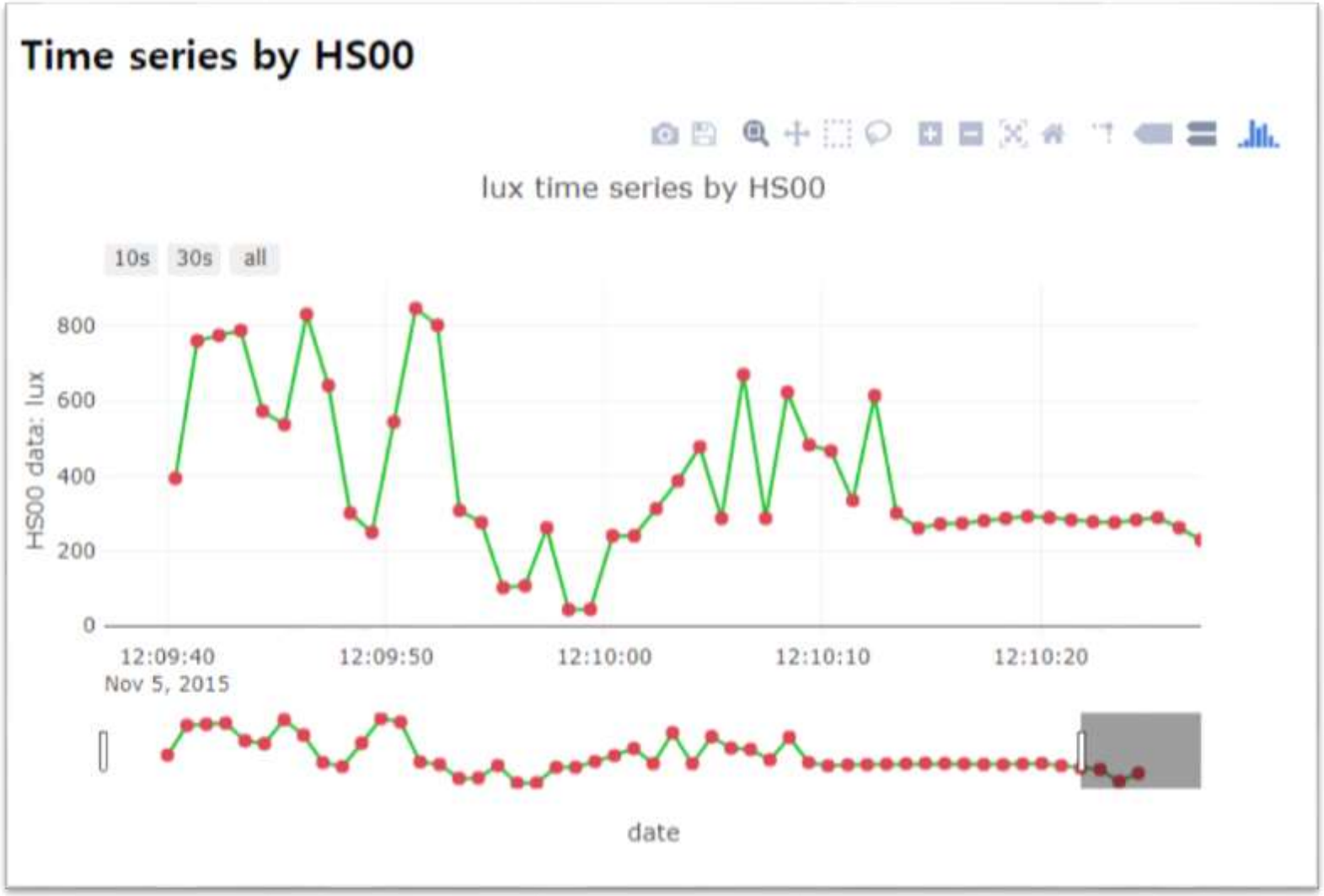
Figure 3
Typical Construction of a Plastic Coated Photocell



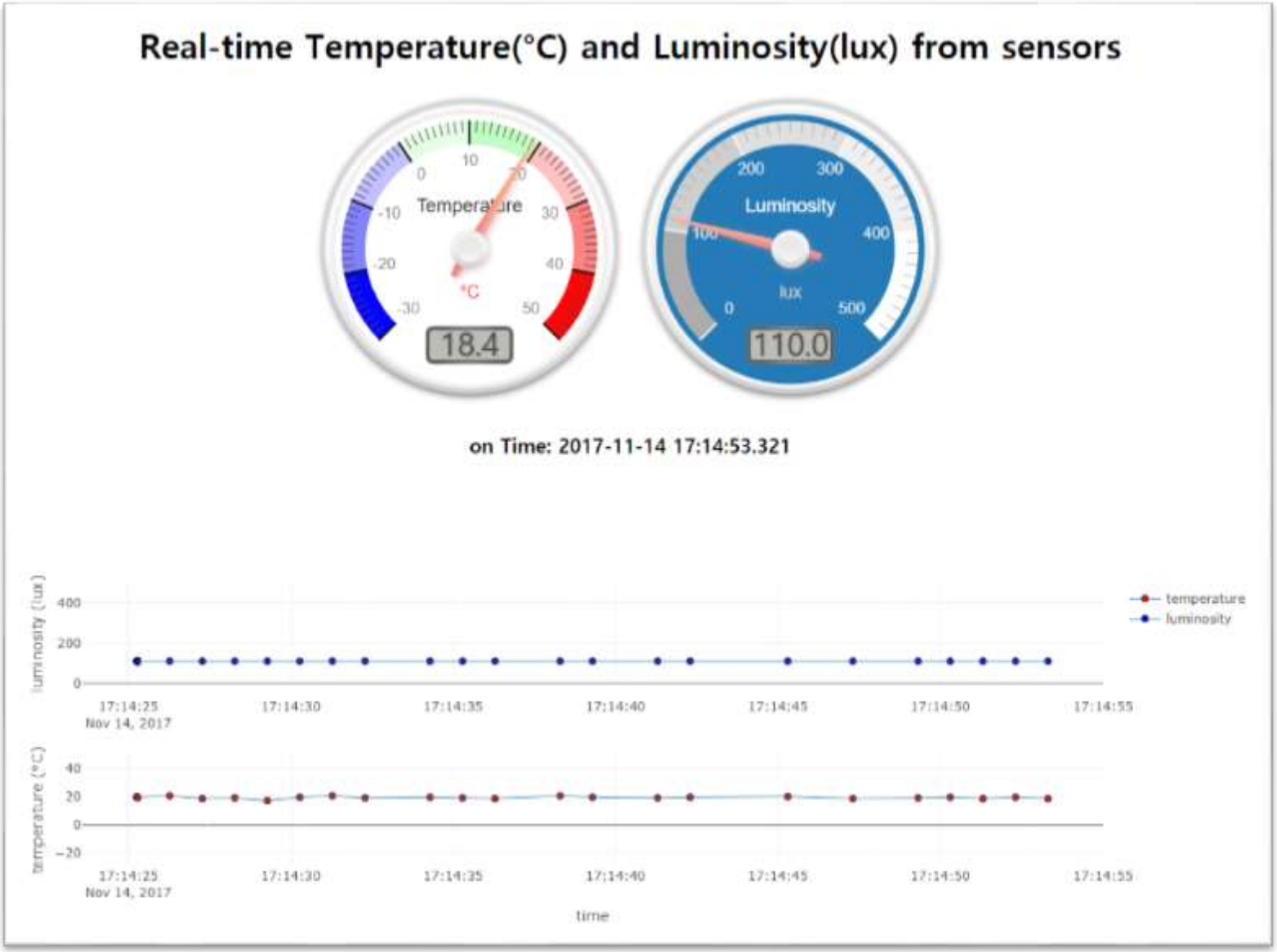
Layout [H S C]

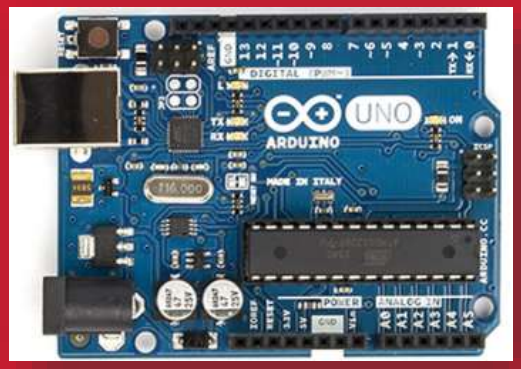

Physical Layer
Photocell
Arduino
USB Cable
Coordination Layer
Computer
Node.js server
Web Browser
Internet
Application Layer
Plotly

Arduino data + plotly

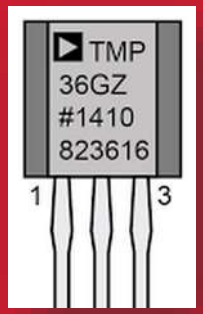


Arduino: node.js + plotly

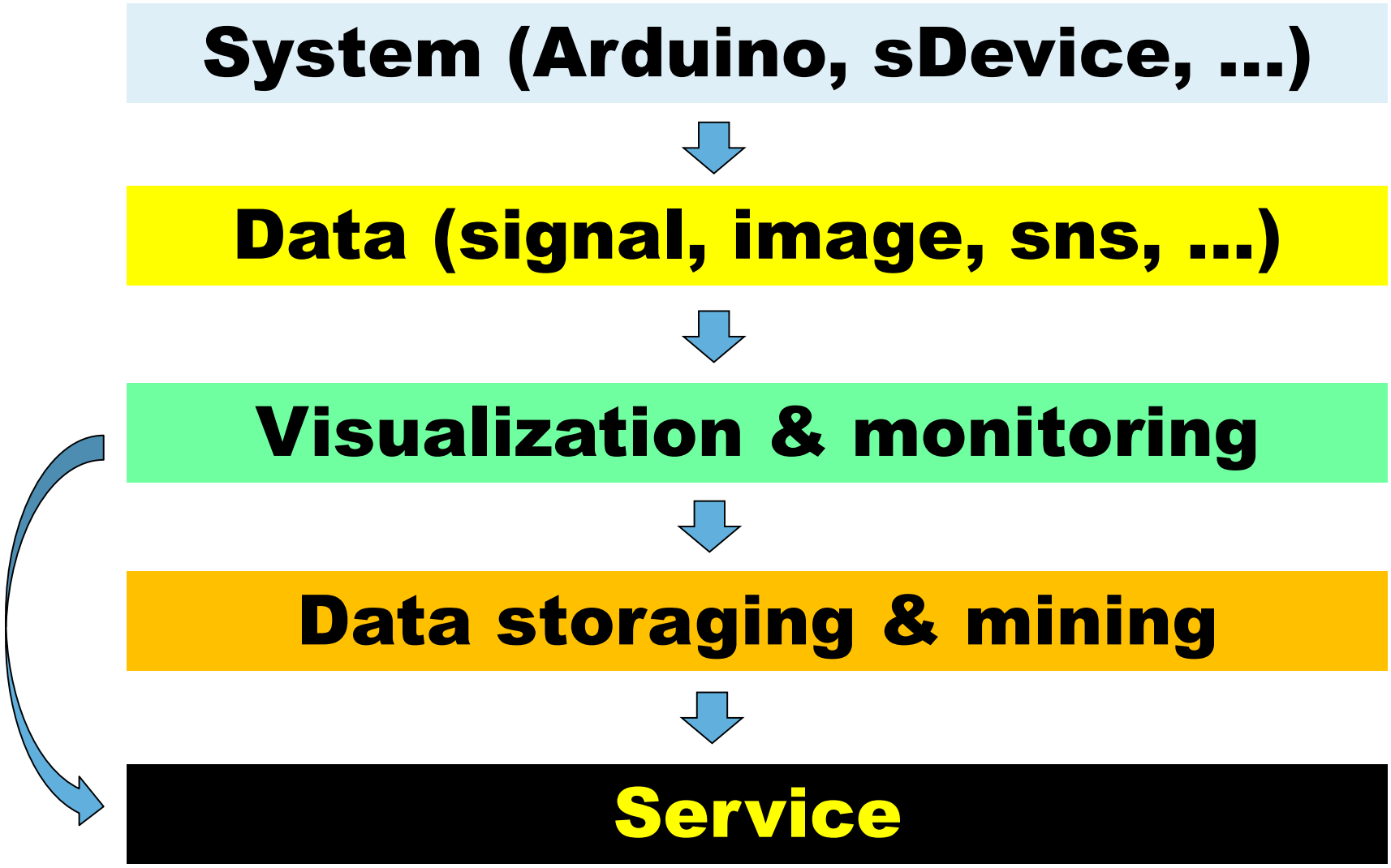




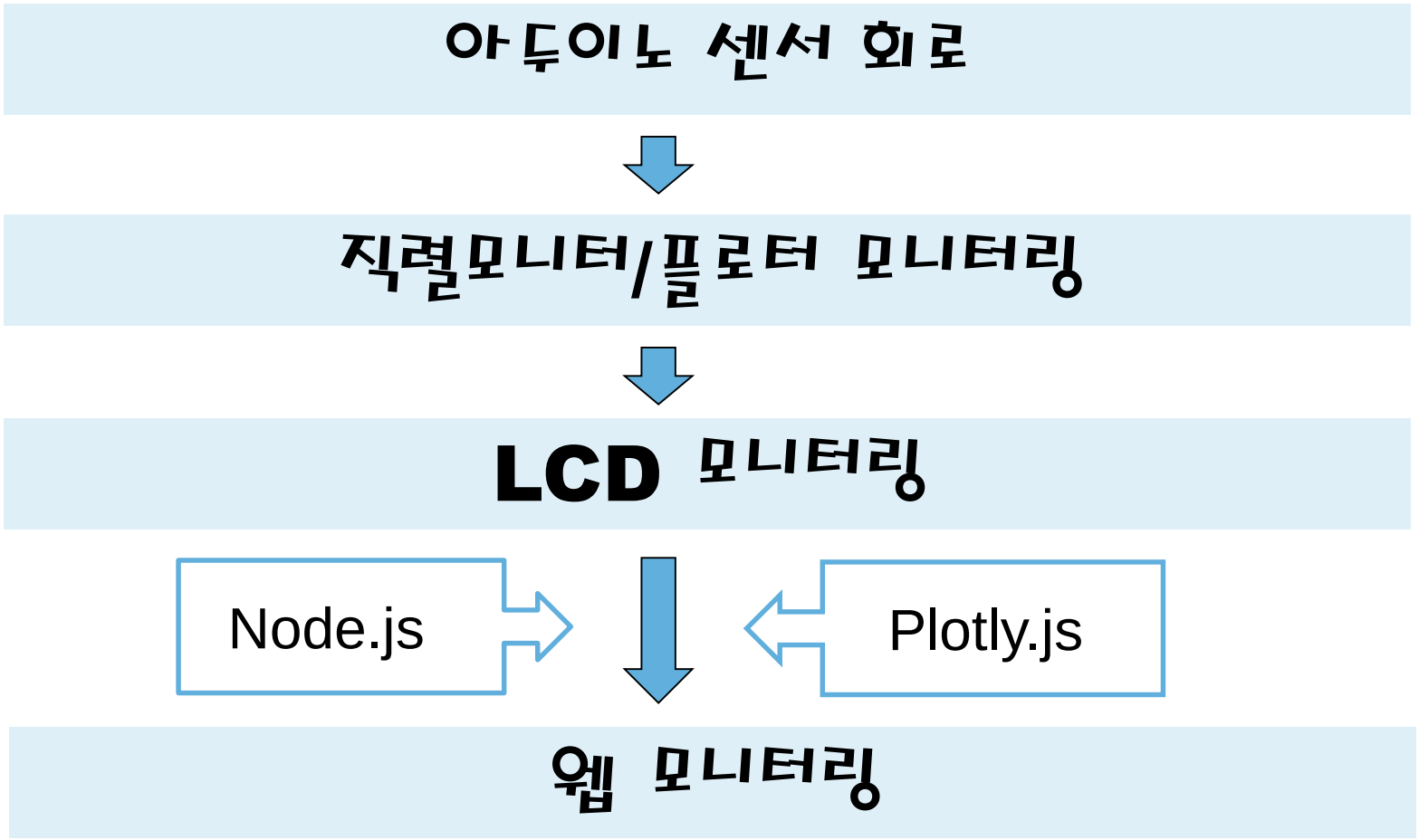
Data visualization using plotly.js

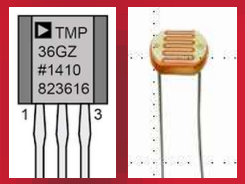


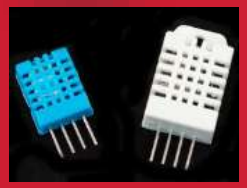
A5. Introduction to visualization



A5.1. Introduction to data visualization

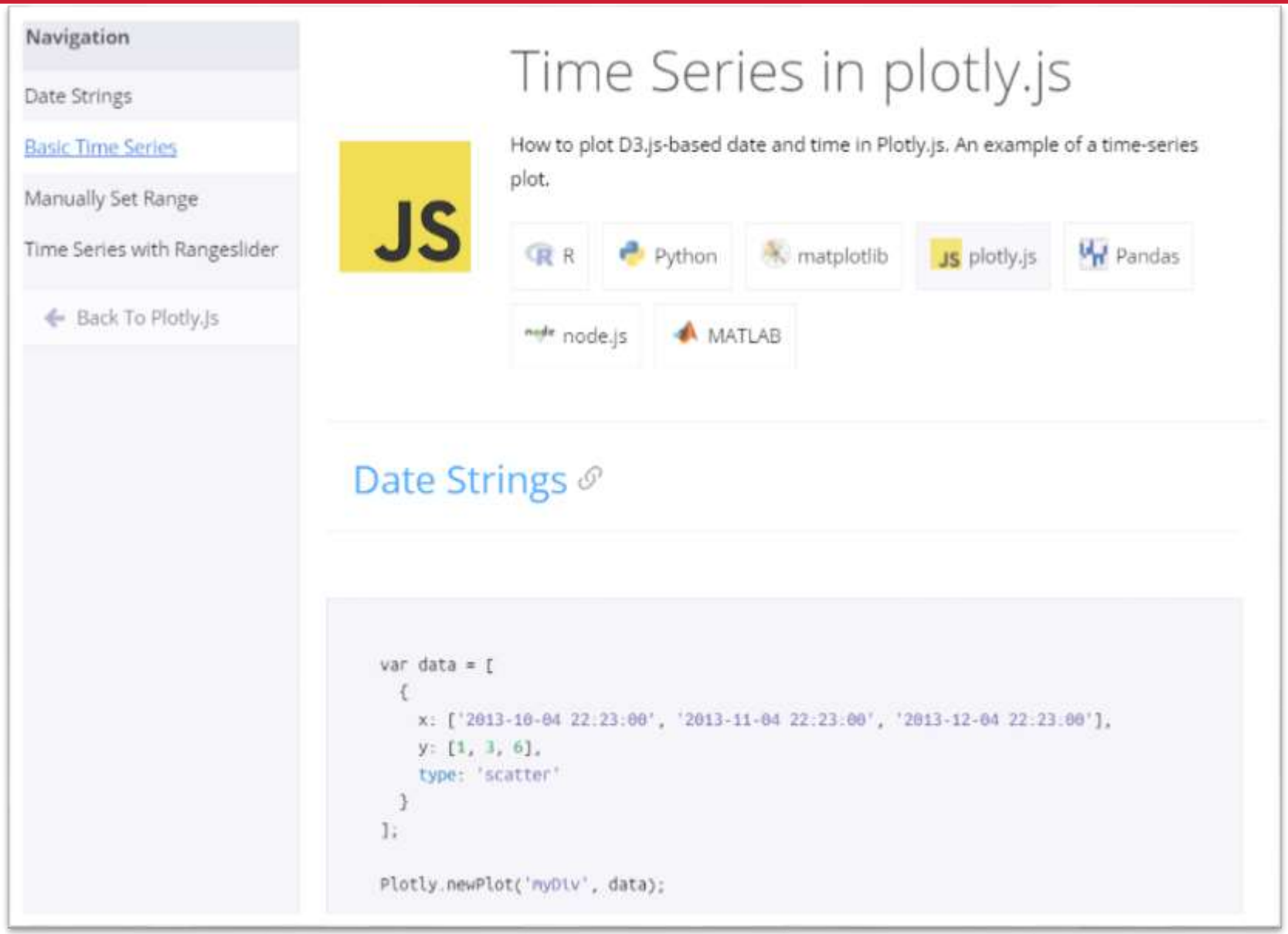






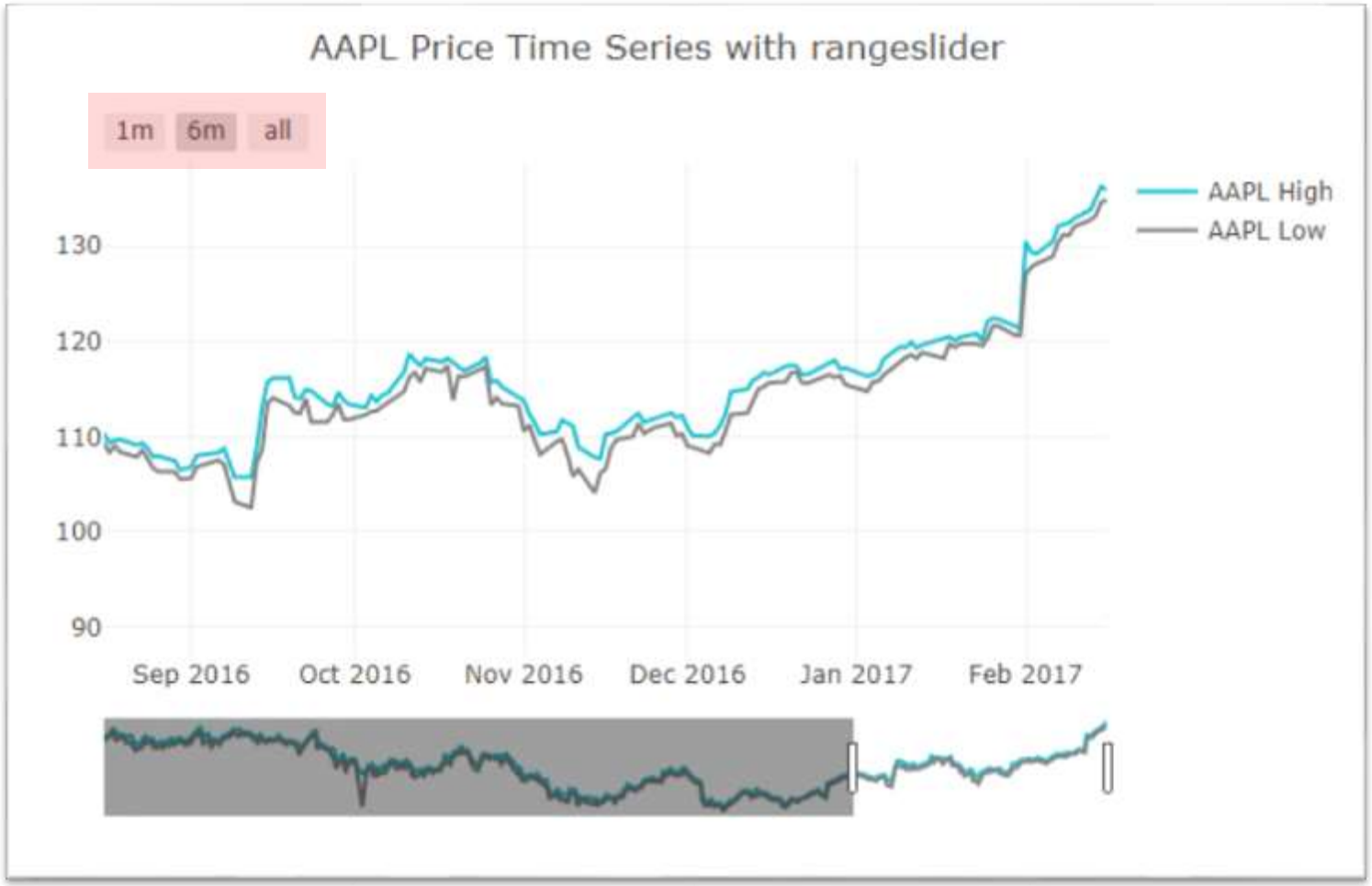
Data visualization using plotly.js

A5.3. Time series



A5.3.3.6 plotly.js: Time series

[2] Time series : financial data strings – Range slider

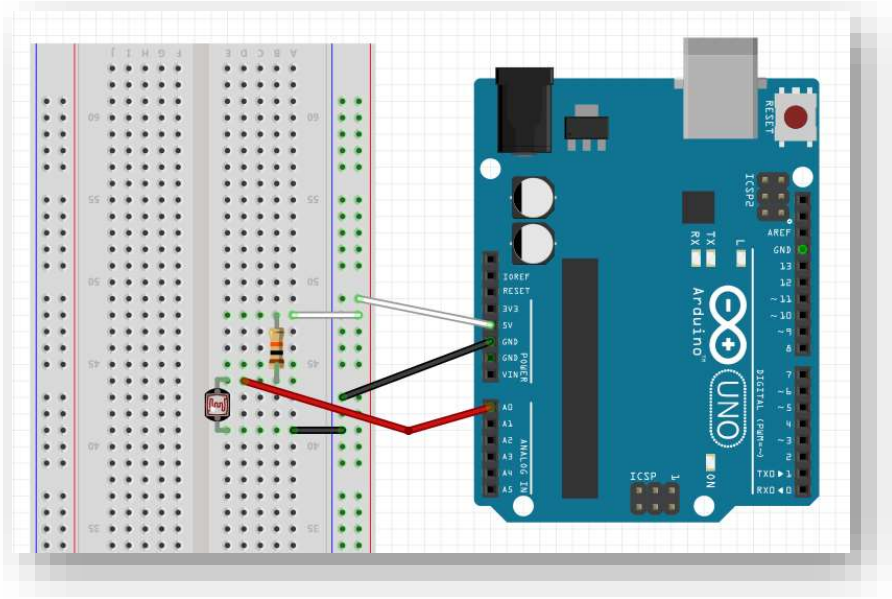


A5.3.4.1 plotly.js: Sensor time series

[3] Time series : my lux data

```
'2015-11-05 12:09:41.382',
'2015-11-05 12:09:42.380',
'2015-11-05 12:09:43.378',
'2015-11-05 12:09:44.377',
'2015-11-05 12:09:45.375',
'2015-11-05 12:09:46.389',
'2015-11-05 12:09:47.388',
'2015-11-05 12:09:48.386',
'2015-11-05 12:09:49.384',
'2015-11-05 12:09:50.383',
'2015-11-05 12:09:51.381',
'2015-11-05 12:09:52.380',
'2015-11-05 12:09:53.394',
'2015-11-05 12:09:54.392',
'2015-11-05 12:09:55.391',
'2015-11-05 12:09:56.389',
'2015-11-05 12:09:57.387',
'2015-11-05 12:09:58.386',
'2015-11-05 12:09:59.384',
'2015-11-05 12:10:00.398',
'2015-11-05 12:10:01.397',
```

Data :
date,value



Project: Time series with Rangeslider

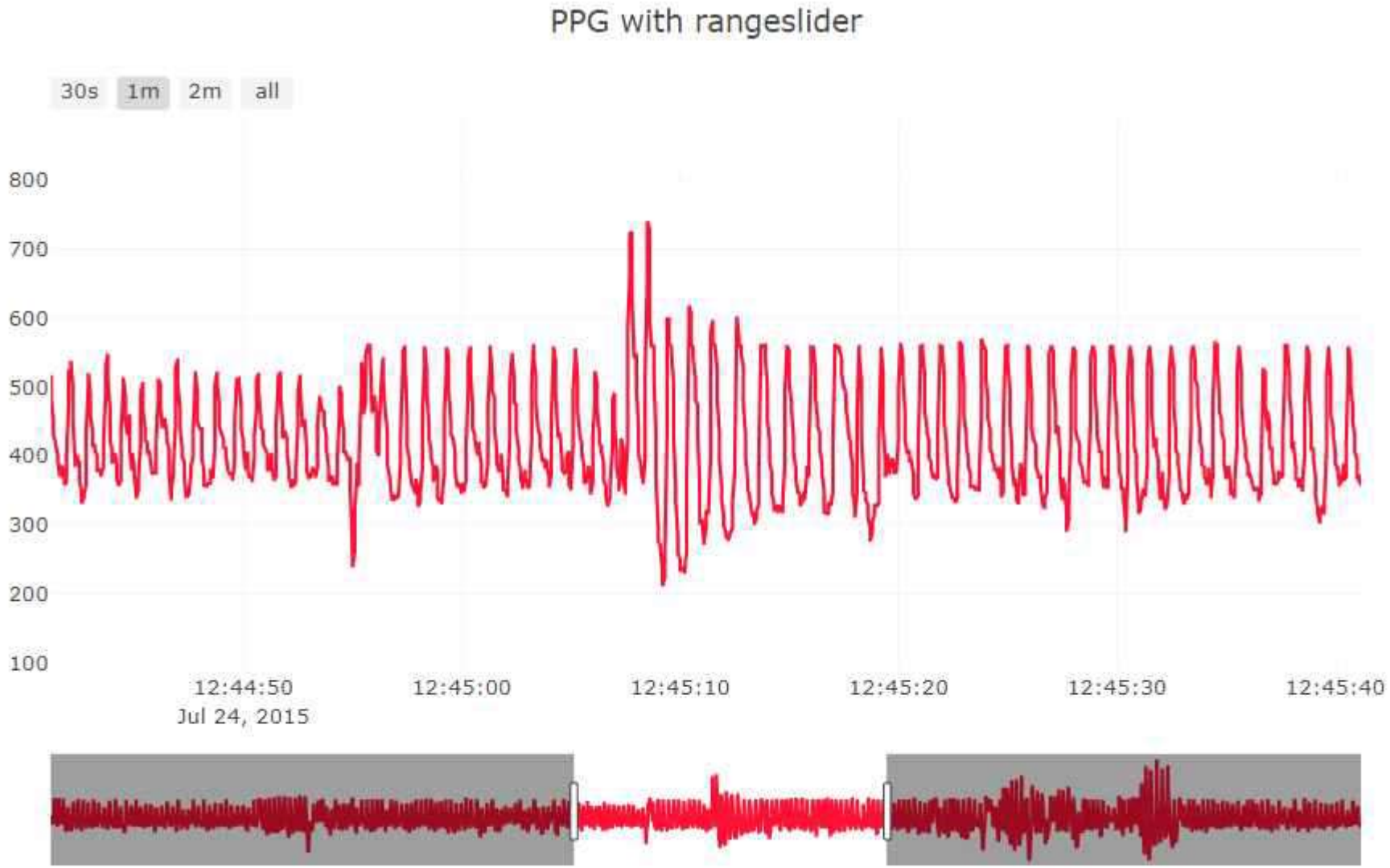
[Project-DIY] HSnn_lux_Rangelslider.html

HSnn_lux_Rangelslider.png

Project: Time series with Rangeslider

```
var layout = {
  title:'lux time series by AAnn',
  width: 750, height: 500,
  margin: {
    l: 50,
    r: 50,
    b: 100,
    t: 100,
    pad: 4
  },
  xaxis: {
    title: 'date',
    autorange: true,
  range: ['2015-11-05 12:09:40.383', '2015-11-05 12:10:30.413'],
  rangeselector: {buttons: [
      {
        count: 10,
        label: '10s',
        step: 'second',
        stepmode: 'backward'
      },
      {
        count: 30,
        label: '30s',
        step: 'second',
        stepmode: 'backward'
      },
      {step: 'all'}
    ]},
  rangeslider: {range: ['2015-11-05 12:09:40.383', '2015-11-05 12:10:30.413']},
  type: 'date'
  },
  yaxis: {
    title: 'AA00 data: lux'
  }
};
```

Remote Time series with Rangeslider



Remote Time series with Rangeslider

	A	B
1	Time	PPG
2	43:00.7	444
3	43:00.8	425
4	43:00.8	423
5	43:00.9	415
6	43:00.9	406
.		
.		
.		
4996	47:12.0	378
4997	47:12.1	364
4998	47:12.1	380
4999	47:12.1	386
5000	47:12.2	371
5001	47:12.3	354

IOT 데이터를 담는 기본 텍스트 파일 형식은 json, csv, txt 등이 있다. 가장 쉽게 사용할 수 있는 데이터 파일로 ‘,’로 데이터 항목을 구분하는 csv 파일이 많이 이용되고 있다.

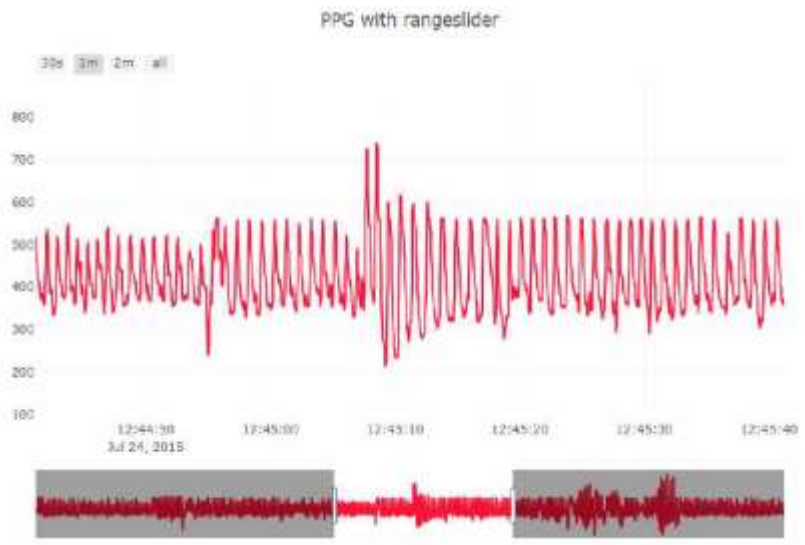
Node.js의 express로 동작하는 원격 서버 내의 폴더에 있는 PPG (Photo PlethysmoGraph, 맥파) 5000개로 구성된 ppg5k.csv 파일을 연결하여 웹으로 살펴본다.

원격 csv 파일을 plotly.js가 지원하는 Plotly.d3.csv() 함수로 읽으면서, callback함수인 unpack() 함수로 헤더에 정의된 key로 각 행에서 시간과 PPG 값을 추출한다.

trace1 객체에 x (시간), y (PPG) 데이터 배열을 만들어 rangeslider가 설정된 원격 시계열 데이터 차트를 그린다.

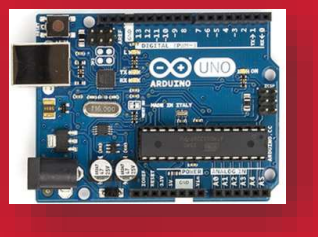
Remote Time series with Rangeslider

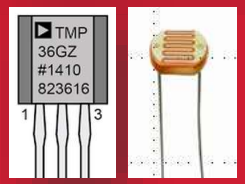
```
Plotly.d3.csv("http://chaos.inje.ac.kr:3030/data/ppg5k.csv", function(err, rows){
    function unpack(rows, key) {
        return rows.map(function(row) { return row[key]; });
    }
    var trace1 = {
        type: "scatter",
        mode: "lines",
        name: 'PPG',
        x: unpack(rows, 'Time'),
        y: unpack(rows, 'PPG'),
        line: {color: '#fc1234'}
    }
```

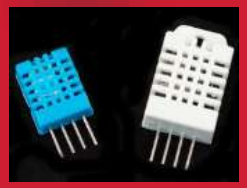


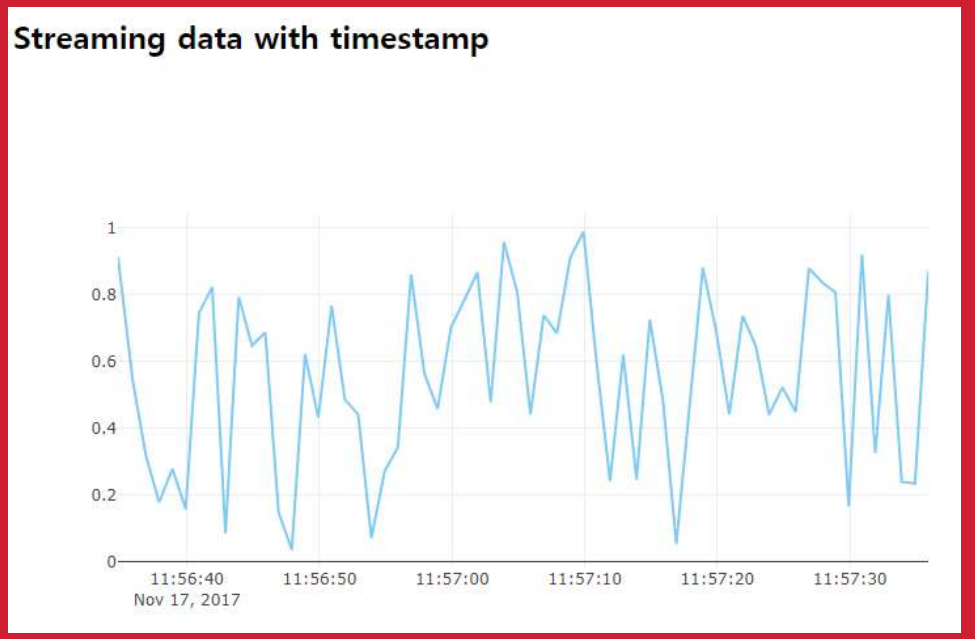

```
var data = [trace1];
var layout = {
    title: 'PPG with rangeslider',
    xaxis: {
        autorange: true,
        range: ['2015-07-24 12:43:00.7', '2015-07-24 12:47:12.3'],
        rangeselector: {buttons: [
            {
                count: 30,
                label: '30s',
                step: 'second',
                stepmode: 'backward'
            },
            {
                count: 1,
                label: '1m',
                step: 'minute',
                stepmode: 'backward'
            },
            {
                count: 2,
                label: '2m',
                step: 'minute',
                stepmode: 'backward'
            },
            {step: 'all'}
            ]},
        rangeslider: {range: ['2015-07-24 12:43:00.7', '2015-07-24 12:47:12.3']},
            type: 'date'
        },
        yaxis: {
            autorange: true,
            range: [100, 800],
            type: 'linear'
        }
    };
Plotly.newPlot('myDiv', data, layout);
```

Data Streaming using plotly.js



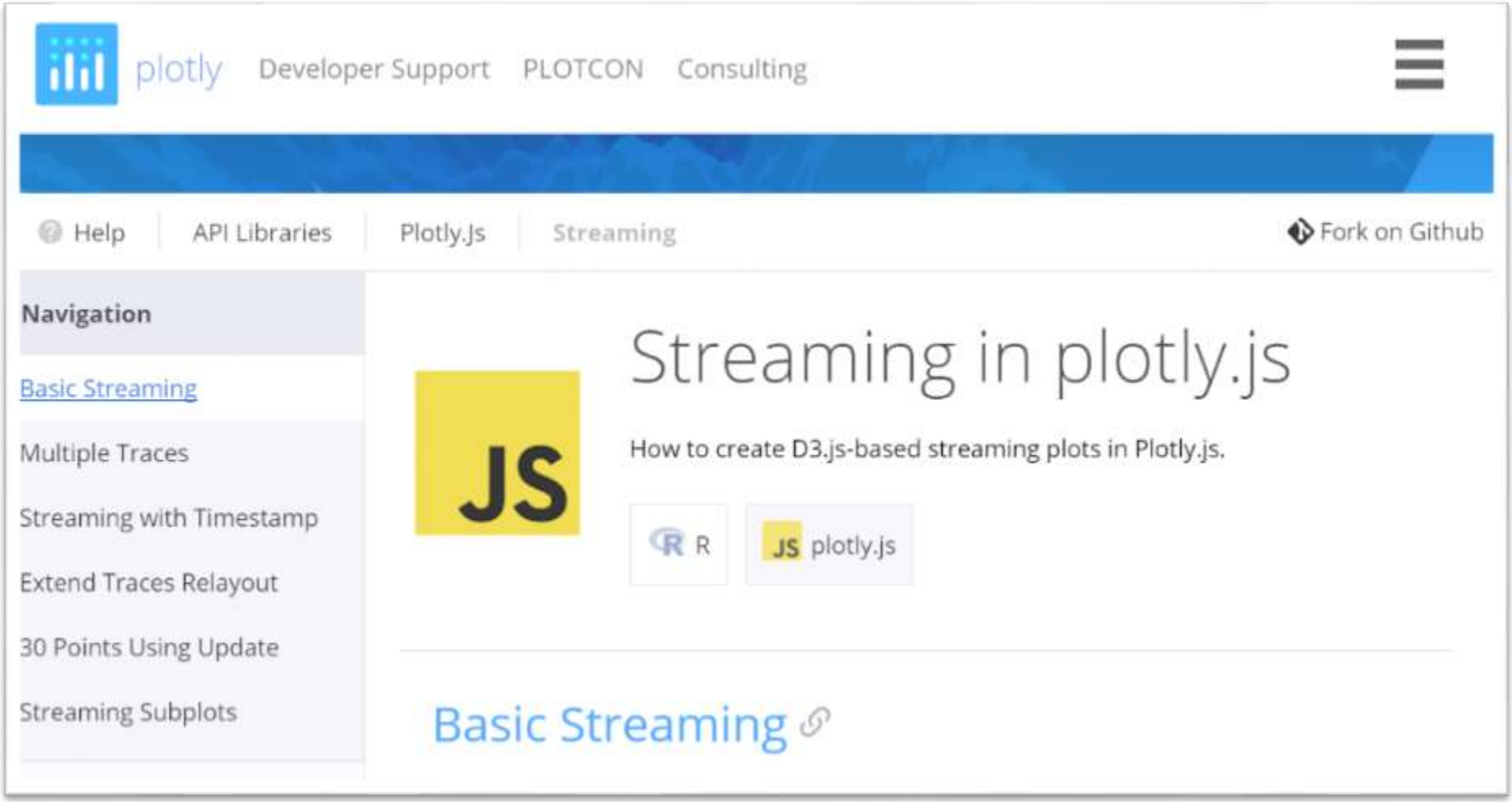






A5.4 plotly.js: Streaming data

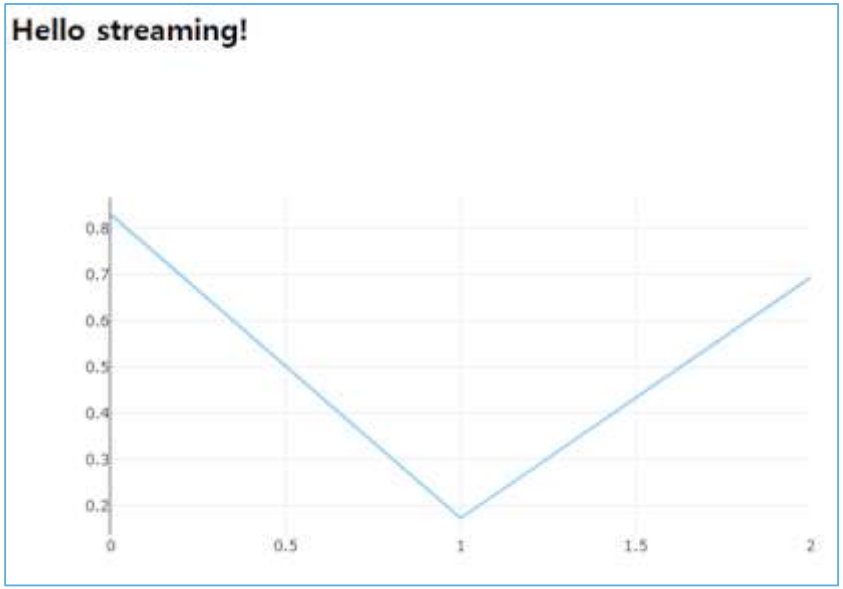
Plot.ly > Streaming



A5.4.1 plotly.js: Streaming data

[1.0] Starting chart

```
<h2>Streaming data</h2>
<div id="graph"></div>

<script>
    function rand() {
        return Math.random(); // 0.0 ~ 1.0
    }

    trace = {
        y: [1,2,3].map(rand),
        mode: 'lines',
        line: {color: '#80CAF6'}
    };

    data = [trace];

    Plotly.plot('graph', data);

    // var cnt = 0;

    // var interval = setInterval(function() {

    //   cnt++;
    //   Plotly.extendTraces('graph', {
    //       y: [[rand()]]
    //   }, [0]);

    //   if(cnt == 50) clearInterval(interval);
    // }, 1000);
</script>
```

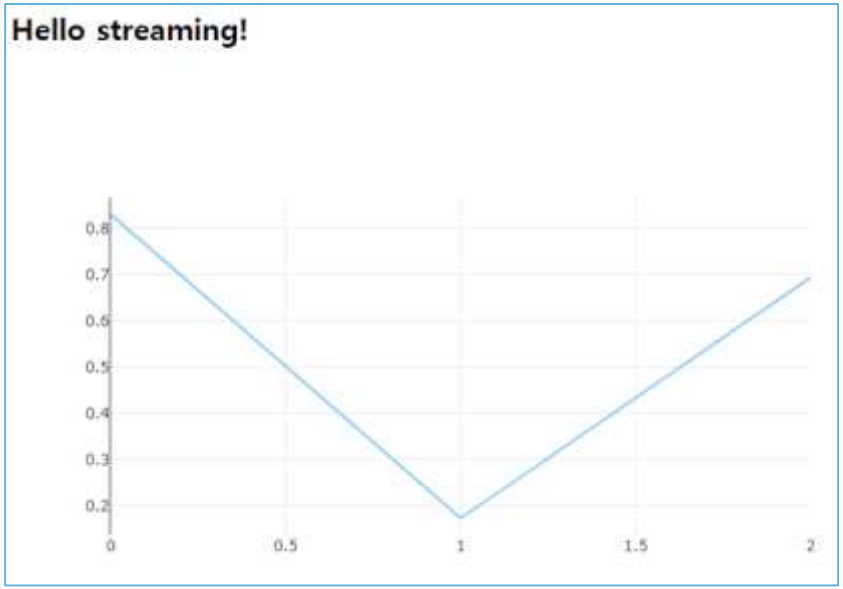


https://developer.mozilla.org/ko/docs/Web/JavaScript/Reference/Global_Objects/Array/map

A5.4.2.1 plotly.js: Streaming data

[1.1] Starting chart (new)

```
<h2>Hello streaming!</h2>

<div id="graph"></div>

<script>
    function rand() {
        return Math.random();
    }

    Plotly.plot('graph', [{
        y: [1,2,3].map(rand),
        mode: 'lines',
        line: {color: '#80CAF6'}
    }]);


    /*var cnt = 0;
    var interval = setInterval(function() {
        cnt++;
        Plotly.extendTraces('graph', {
            y: [[rand()]]
        }, [0]);
        if(cnt == 30) clearInterval(interval);
    }, 2000);*/
</script>
```



A6.4.2.2 plotly.js: Streaming data

[1.2] Basic streaming

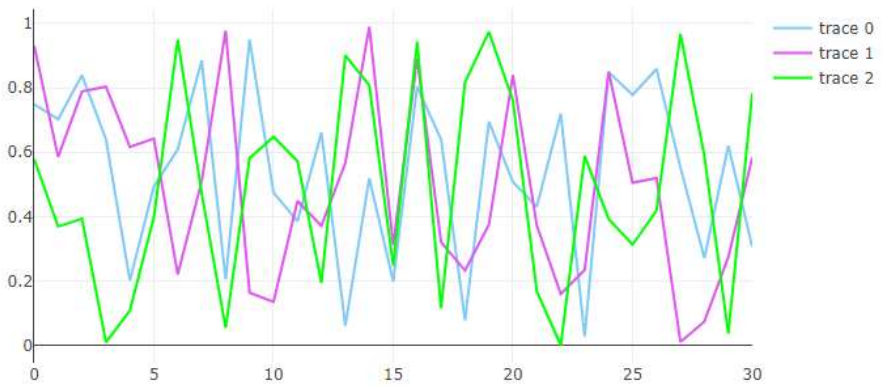
```
<h2>Streaming data!</h2>

<div id="graph"></div>

<script>
    function rand() {
        return Math.random();
    }

    Plotly.plot('graph', [{
        y: [1,2,3].map(rand),
        mode: 'lines',
        line: {color: '#80CAF6'}
    }]);

    var cnt = 0;
    var interval = setInterval(function() {
        cnt++;
        Plotly.extendTraces('graph', {
            y: [[rand()]]
        }, [0]);
        if(cnt == 30) clearInterval(interval);
    }, 2000);
</script>
```

A5.4.3.1 plotly.js: Streaming data

[2.1] Streaming multiple traces

```
function rand() {
    return Math.random();
}

// initial plot
trace1 = {
    y: [1,2,3].map(rand),
    mode: 'lines',
    line: {color: '#80CAF6'}
};
trace2 = {
    y: [1,2,3].map(rand),
    mode: 'lines',
    line: {color: '#DF56F1'}
};
trace3 = {
    y: [1,2,3].map(rand),
    mode: 'lines',
    line: {color: '#00FF00'}
};

data = [trace1, trace2, trace3];

Plotly.plot('graph', data);
```

```
// continous plot
var cnt = 0;
var interval = setInterval(function() {

    Plotly.extendTraces('graph', {
        y: [[rand()], [rand()], [rand()]]
    }, [0, 1, 2])

    cnt++;
    if(cnt === 100) clearInterval(interval);
}, 300);
```

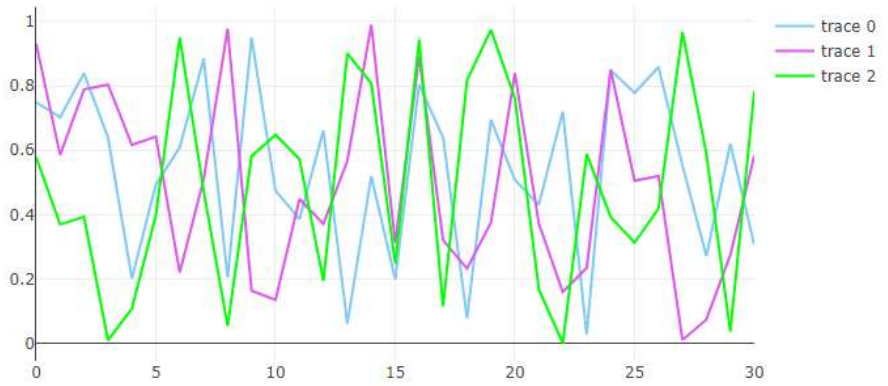


A5.4.3.2 plotly.js: Streaming data

[2.2] Streaming multiple traces (new code)

```
function rand() {
    return Math.random();
}

// initial plot
Plotly.plot('graph', [{
    y: [1,2,3].map(rand),
    mode: 'lines',
    line: {color: '#80CAF6'}
}, {
    y: [1,2,3].map(rand),
    mode: 'lines',
    line: {color: '#DF56F1'}
}, {
    y: [1,2,3].map(rand),
    mode: 'lines',
    line: {color: '#00FF00'}
}]);
```

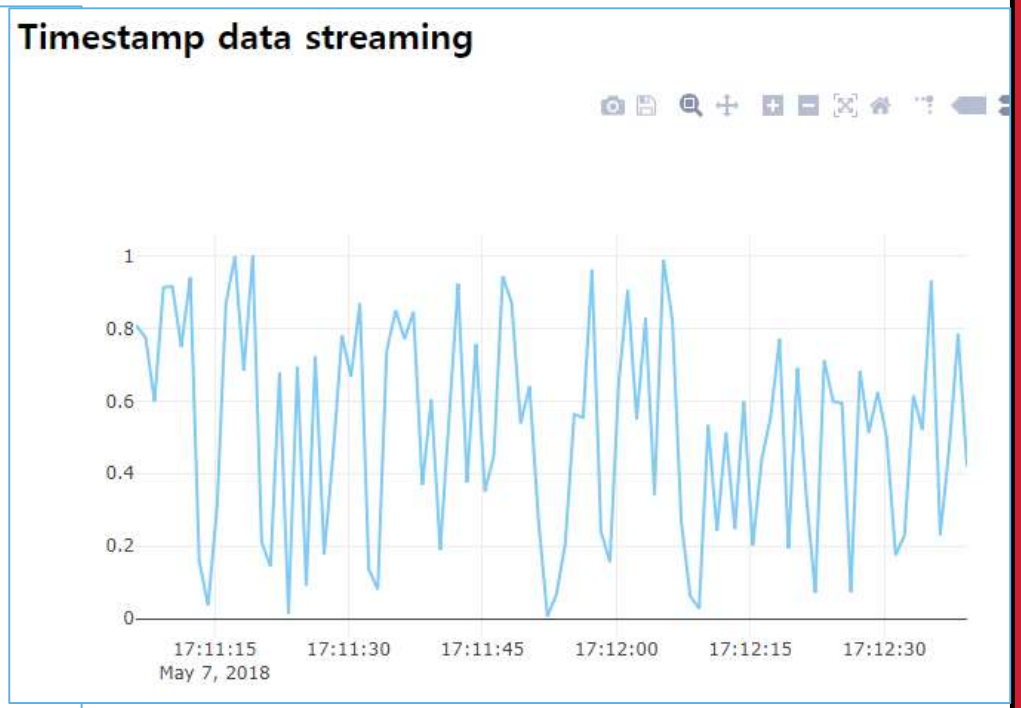
```
// continous plot
var cnt = 0;
var interval = setInterval(function() {

    Plotly.extendTraces('graph', {
        y: [[rand()], [rand()], [rand()]]
    }, [0, 1, 2])

    cnt++;

    if(cnt === 100) clearInterval(interval);
}, 300);
```



A5.4.4 plotly.js: Streaming data

[3] Streaming data with timestamp

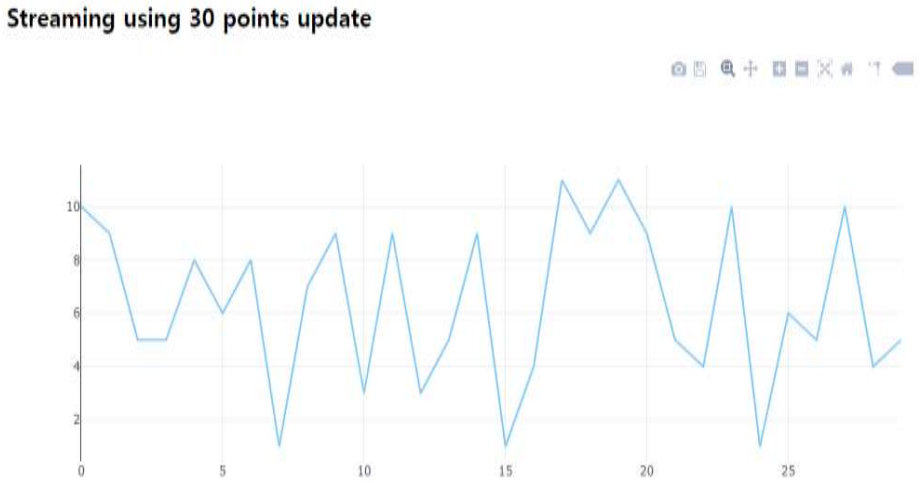
```
function rand() {
    return Math.random();
}

var time = new Date();
var data = [{
    x: [time],
    y: [rand()],
    mode: 'lines',
    line: {color: '#80CAF6'}
}]

Plotly.plot('graph', data);

var cnt = 0;

var interval = setInterval(function() {

    var time = new Date();

    var update = {
        x:  [[time]],
        y: [[rand()]]
    }

    Plotly.extendTraces('graph', update, [0])

    if(cnt === 100) clearInterval(interval);
}, 1000);
```



A5.4.5 plotly.js: Streaming data

[4] Streaming data using 30 points update

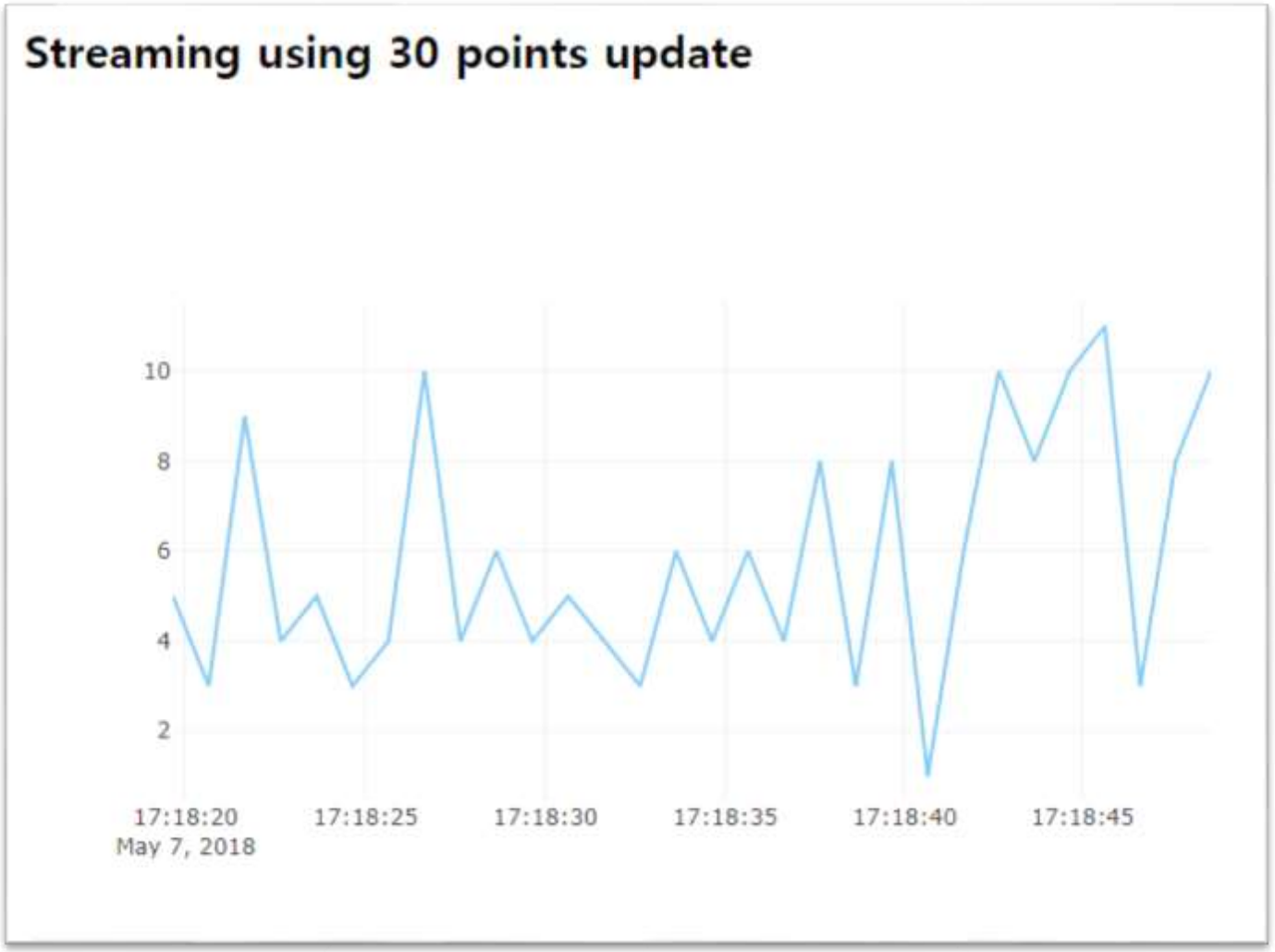
```
var arrayLength = 30
var newArray = []

// initial 30 data
for(var i = 0; i < arrayLength; i++) {
    var y = Math.round(Math.random()*10) + 1
    newArray[i] = y
}

var data = [{
    y: newArray,
    mode: 'lines',
    line: {color: '#80CAF6'}
}]

Plotly.plot('graph', data);
```




```
var cnt = 0;
var interval = setInterval(function() {

    var y = Math.round(Math.random()*10) + 1
    newArray = newArray.concat(y)
    newArray.splice(0, 1)//remove the oldest data

    var update = {
        y:  [newArray]
    }

    Plotly.update('graph', update)
    //cnt++;
    if(cnt === 50) clearInterval(interval);
}, 1000);
```

A5.4.5.1 plotly.js: Streaming data

[4.1] Streaming data using 30 points update (with timestamp)



A5.4.5.2 plotly.js: Streaming data

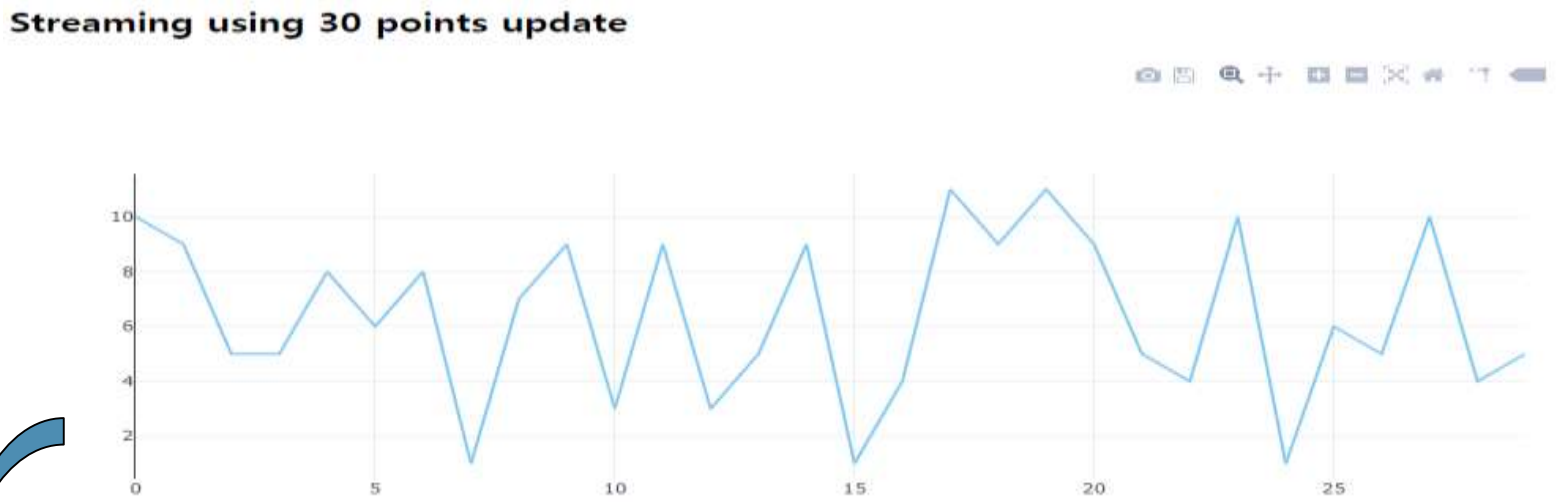
[4.2] Streaming data using 30 points update

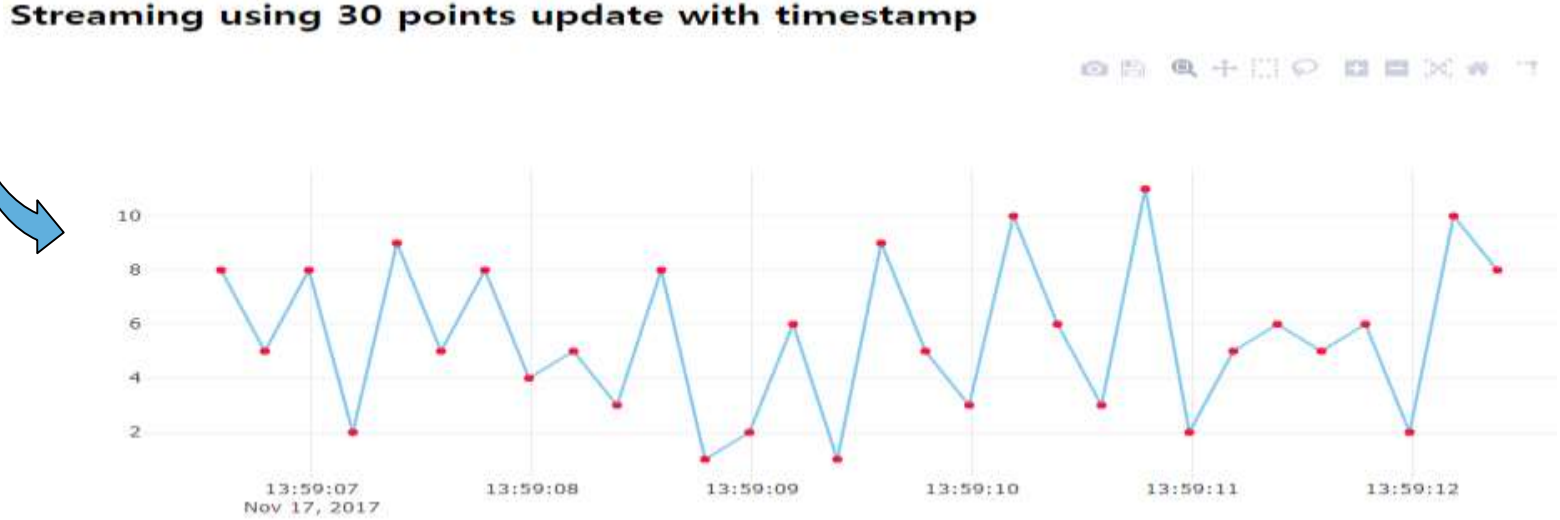
```
<h2>Streaming using 30 points update</h2>

<div id="graph"></div>

<script>
    var arrayLength = 30
    var newArray = []
    var timeArray = []
    // initial 30 data
    for(var i = 0; i < arrayLength; i++) {
        var y = Math.round(Math.random()*10) + 1
        var time = new Date();
        newArray[i] = y
        timeArray[i] = time
    }

    var data = [{
        x: timeArray,
        y: newArray,
        mode: 'lines',
        line: {color: '#80CAF6'}
    }]

    Plotly.plot('graph', data);
```

```
var cnt = 0;

var interval = setInterval(function() {

    var y = Math.round(Math.random()*10) + 1
    var time = new Date();

    timeArray = timeArray.concat(time)
    timeArray.splice(0, 1)//remove the oldest data
    newArray = newArray.concat(y)
    newArray.splice(0, 1)//remove the oldest data

    var update = {
        x:  [timeArray],
        y:  [newArray]
    }

    Plotly.update('graph', update)

    if(cnt === 100) clearInterval(interval);
}, 1000);
```

A5.4.5.3 plotly.js: Streaming data

[DIY] Streaming time series using 30 points update





HSnn_DS_30timestamps.png 로 캡처 저장.

A5.4.5.4 plotly.js: Streaming data

[DIY-hint] Streaming time series using 30 points update

```
<script>
    var arrayLength = 30
    var newArray = []
    var timeArray = []

    // initial 30 data
    for(var i = 0; i < arrayLength; i++) {
        var y = Math.round(Math.random()*10) + 1
        var time = new Date();
        newArray[i] = y
        timeArray[i] = time
    }

    var data = [{
        x: timeArray,
        y: newArray,
        mode: 'lines+markers',
        line: {color: '#80CAF6'},
        marker: {color: '#FC1234'}
    }]


    Plotly.plot('graph', data);
```

A5.4.6 plotly.js: Streaming data

[5] Streaming data using multiple axis

A5.4.6.1 plotly.js: Streaming data

[5.1] Streaming data using multiple axis

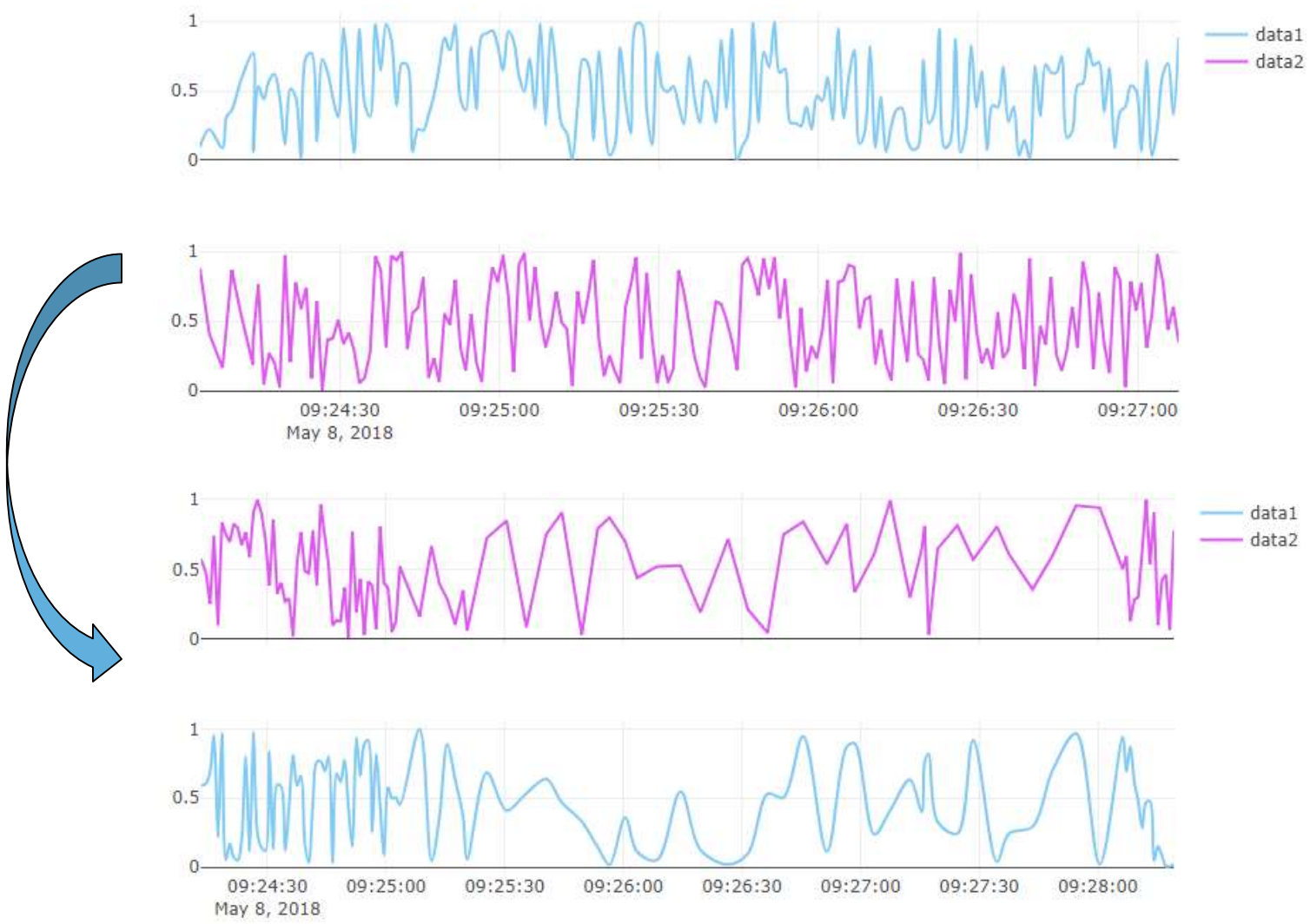
```
<h2>Multiple axis data streaming</h2>

<div id="graph"></div>

<script>
    function rand() {
        return Math.random();
    }

    var time = new Date();

    var trace1 = {
        x: [],
        y: [],
        mode: 'lines',
        line: {
            color: '#80CAF6',
            shape: 'spline'
        },
        name: 'data1'
    }
    var trace2 = {
        x: [],
        y: [],
        xaxis: 'x2',
        yaxis: 'y2',
        mode: 'lines',
        line: {color: '#DF56F1'},
        name: 'data2'
    };
```

```
var layout = {
    xaxis: {
        type: 'date',
        domain: [0, 1],
        showticklabels: false
    },
    yaxis: {domain: [0.6,1]},
    xaxis2: {
        type: 'date',
        anchor: 'y2',
        domain: [0, 1]
    },
    yaxis2: {
        anchor: 'x2',
        domain: [0, 0.4]},
    }

    var data = [trace1,trace2];
    Plotly.plot('graph', data, layout);
```

```
// streaming
var cnt = 0;
var interval = setInterval(function() {

    var time = new Date();

    var update = {
        x: [[time], [time]],
        y: [[rand()], [rand()]]
    }

    Plotly.extendTraces('graph', update, [0,1])
    // cnt++;
    if(cnt === 100) clearInterval(interval);
}, 1000);
```

A5.4.6.2 plotly.js: Streaming data

[DIY] Streaming data using multiple axis → change axis

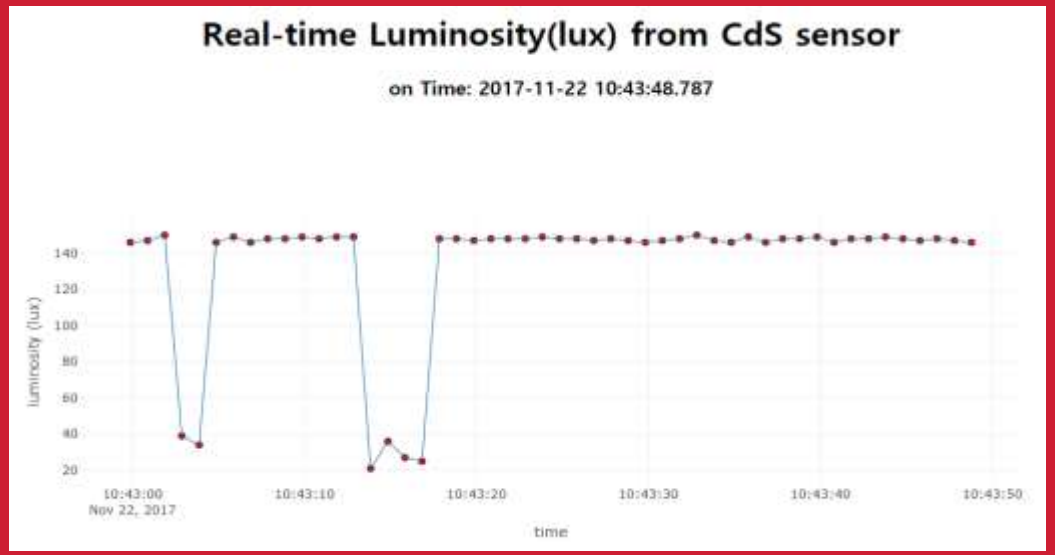


HSnn_DS_multiple_axis.png 로 캡처 저장.

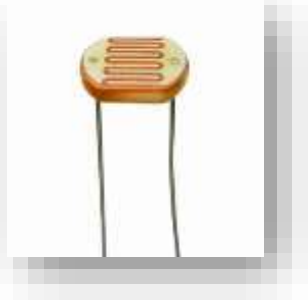
Arduino sensor data

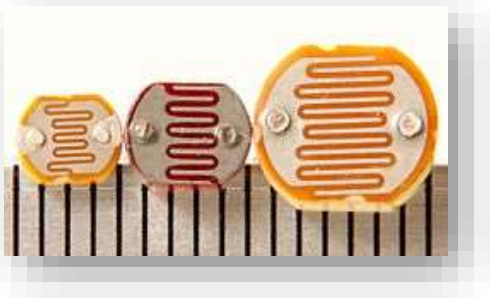
RT visualization using plotly.js

```
AA00,2017-11-22 10:43:11.859,149
AA00,2017-11-22 10:43:12.851,149
AA00,2017-11-22 10:43:13.845,21
AA00,2017-11-22 10:43:14.854,36
AA00,2017-11-22 10:43:15.844,27
AA00,2017-11-22 10:43:16.837,25
AA00,2017-11-22 10:43:17.846,148
AA00,2017-11-22 10:43:18.839,148
AA00,2017-11-22 10:43:19.847,147
```

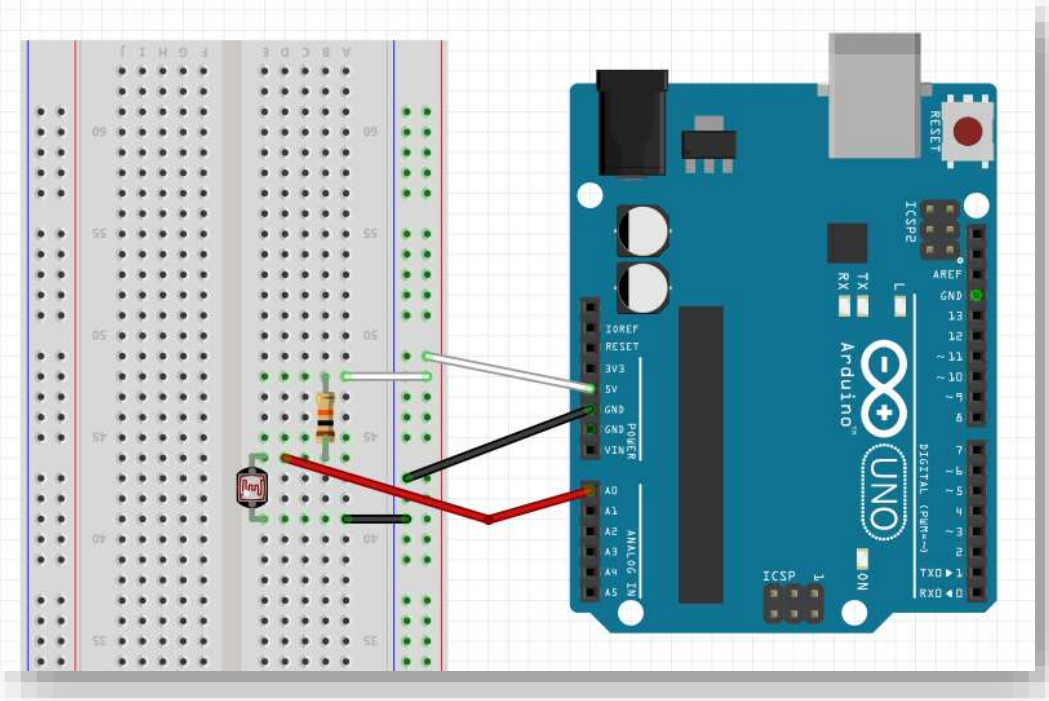


Luminosity sensor [Photocell LDR]

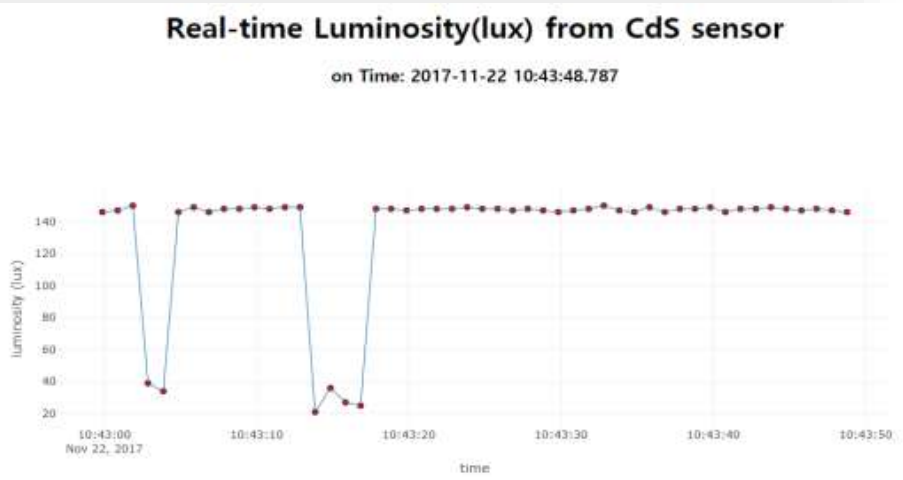




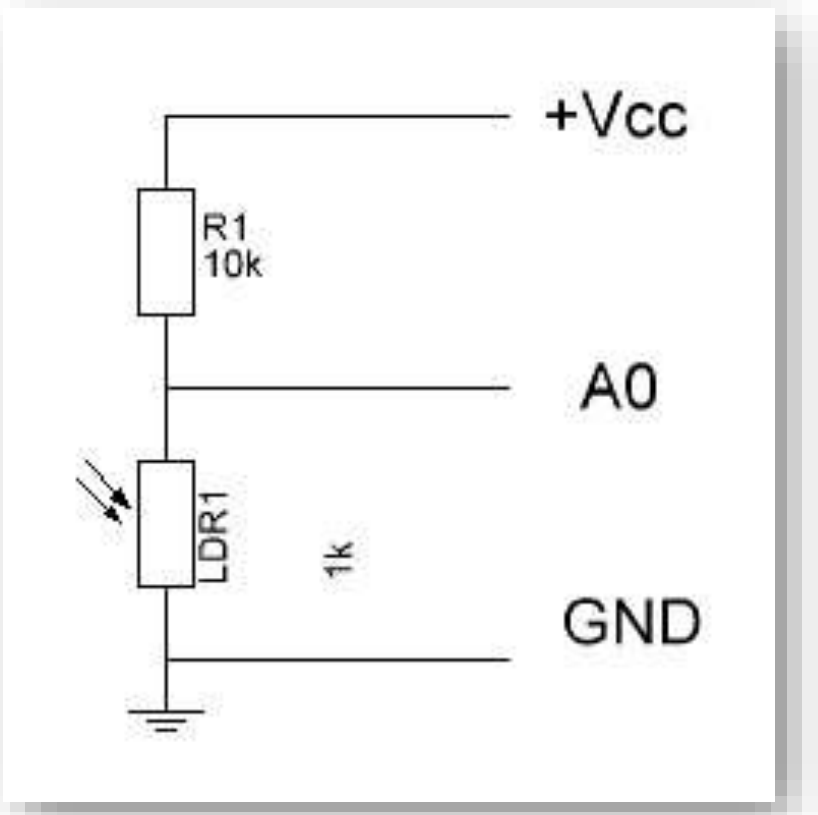
CdS




```
AA00,2017-11-22 10:43:11.859,149
AA00,2017-11-22 10:43:12.851,149
AA00,2017-11-22 10:43:13.845,21
AA00,2017-11-22 10:43:14.854,36
AA00,2017-11-22 10:43:15.844,27
AA00,2017-11-22 10:43:16.837,25
AA00,2017-11-22 10:43:17.846,148
AA00,2017-11-22 10:43:18.839,148
AA00,2017-11-22 10:43:19.847,147
```



CdS 센서 회로 분석



Ao → Vo → lux

lux = 500 / R_{ldr}

Vo = I_{ldr} * R_{ldr}

= (5/(10 + R_{ldr}))* R_{ldr}

R_{ldr} = 10*Vo / (5 – Vo)

lux = 250/Vo – 50

Vo = 5.0 * Ao / 1023.0

```
//Voltage to Lux
double luminosity (int RawADC0){
  double Vout=RawADC0*5.0/1023.0;  // 5/1023 (Vin = 5 V)
  double lux=(2500/Vout-500)/10.0;
  // lux = 500 / Rldr, Vout = Ildr*Rldr = (5/(10 + Rldr))*Rldr
  return lux;
}
```

A3.2.6 Luminosity sensor [Photocell LDR]

CdS 센서 회로 - 측정 2.

sketch08_CdS2

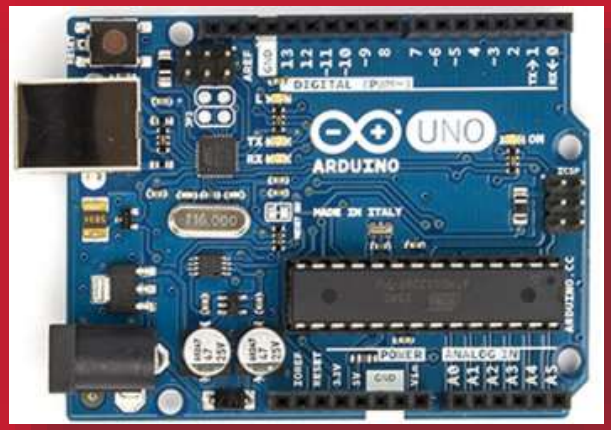
```
1  //  lux
2  #define CDS_INPUT 0
3
4  void setup() {
5  Serial.begin(9600);
6  }
7  void loop() {
8    int value = analogRead(CDS_INPUT);
9    Serial.println(int(luminosity(value)));
10   delay(1000);
11 }
12
13 //Voltage to Lux
14 double luminosity (int RawADC0){
15   double Vout=RawADC0*5.0/1023;  // 5/1023 (Vin = 5 V)
16   double lux=(2500/Vout-500)/10;
17   // lux = 500 / Rldr, Vout = Ildr*Rldr = (5/(10 + Rldr))*Rldr
18   return lux;
19 }
```

COM11 (Arduino/Genuino Uno)

```
23
24
23
183
191
183
185
531
1169
1262
1198
1039
1063
```

밝을수록 측정 값이 커지고
어두을수록 값이 작아진다 !!!

Single sensor: CdS



CdS (LDR)

Node project

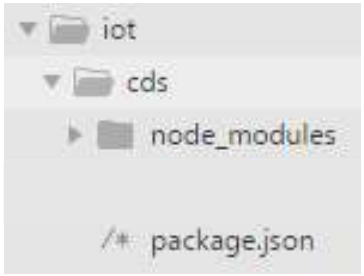
A4.2.1 Luminosity sensor [Photocell LDR]

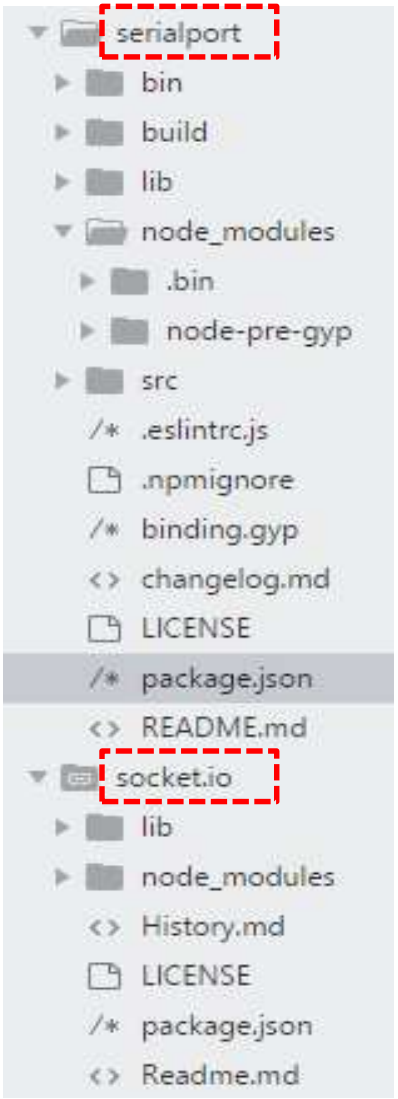
1. Make cds node project
   - md cds in iot folder
   - cd cds
2. Go to cds subfolder
   - npm init

"main": "cds_node.js"
"author": "hsnn"

A4.2.2 Luminosity sensor [Photocell LDR]

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





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

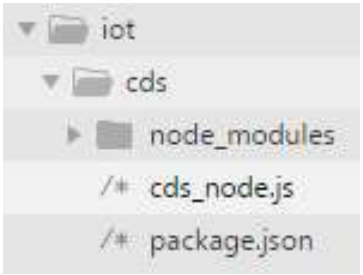
A4.2.3 Luminosity sensor [Photocell LDR]

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

package,json

```
{
  "name": "cds",
  "version": "1.0.0",
  "description": "cds-node project",
  "main": "cds_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"
  }
}
```

A4.2.4 Luminosity sensor [Photocell LDR]



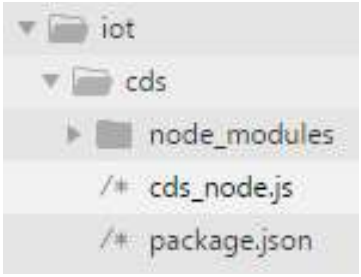
Save tmp36_node.js as cds_node.js

```
var dStr = '';
var tdata = [];

sp.on('data', function (data) { // call back when data is received
    // raw data only
        //console.log(data);
        dStr = getDateString();
        tdata[0] = dStr;  // date
        tdata[1] = data;  // data
        console.log("AA00," + tdata);
        io.sockets.emit('message', tdata);  // send data to all clients
});

// helper function to get a nicely formatted date string
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;
}
```

A4.2.5 cds_ node project (실행 결과)

▸ Sublime Text 3에서 실행

```
AA00,2018-01-14 19:12:42.037,86
AA00,2018-01-14 19:12:43.035,36
AA00,2018-01-14 19:12:44.039,54
AA00,2018-01-14 19:12:45.038,175
AA00,2018-01-14 19:12:46.042,175
AA00,2018-01-14 19:12:47.041,174
```

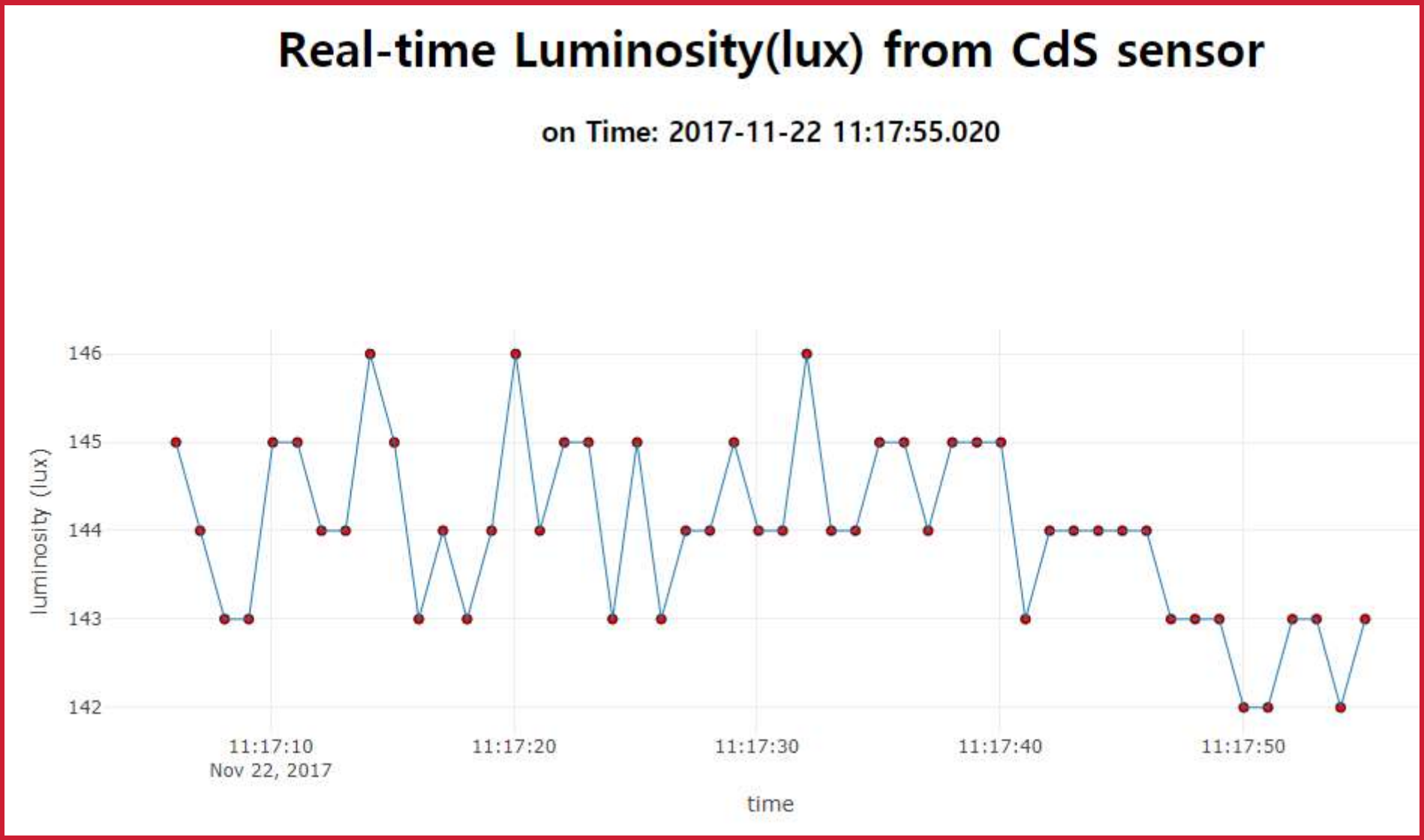


▸ Node cmd에서 실행

```
node cds_node
```

```
NodeJS - node  cds_node

D:\Portable\NodeJSPortable\Data\aa00\iot\cds>node cds_node
AA00,2018-01-14 19:15:33.602,176
AA00,2018-01-14 19:15:34.601,45
AA00,2018-01-14 19:15:35.601,35
AA00,2018-01-14 19:15:36.604,33
AA00,2018-01-14 19:15:37.604,175
```

```
io.sockets.emit('message', tdata);  // send data to all clients
```



A5.5.1 RT sensor-data streaming in Arduino

[1] Client html : client_cds.html (using socket.io.js)

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

[2] Client html : client_cds.html (global variables)

```
<body>  <!-- style="width:100%;height:100%"> -->
<!-- Plotly chart will be drawn inside this DIV -->
<h1 align="center"> Real-time Luminosity(lux) from CdS sensor </h1>

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

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

<hr>

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

    var tArray = [], // time of data arrival
        xTrack = [], // value of CdS sensor 1 : lux
        numPts = 50, // number of data points
        dtda = [],  // 1 x 2 array : [date, lux] from CdS
        preX = -1,  // check change in data
        initFlag = true;
```

[3] Client html : client_cds.html (socket connection & handling message)

```
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]=parseInt(msg[1]);  // lux
            init();  // start streaming
            initFlag=false;
        }
        console.log(msg[0]);
        console.log(parseInt(msg[1])); // Convert value to integer
        dtda[0]=msg[0];
        dtda[1] = parseInt(msg[1]);

        // when new data is coming, keep on streaming data
        ctime.innerHTML = dtda[0];
        nextPt();
    });
});
```

[4] Client html : client_cds.html (init() & nextPt())

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

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

function nextPt() {

    tArray.shift();
    tArray.push(dtda[0]);

    xTrack.shift();
    xTrack.push(dtda[1]);  // CdS sensor: lux

    Plotly.redraw(streamPlot);
}
```

[5] Client html : client_cds.html (data & layout)

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

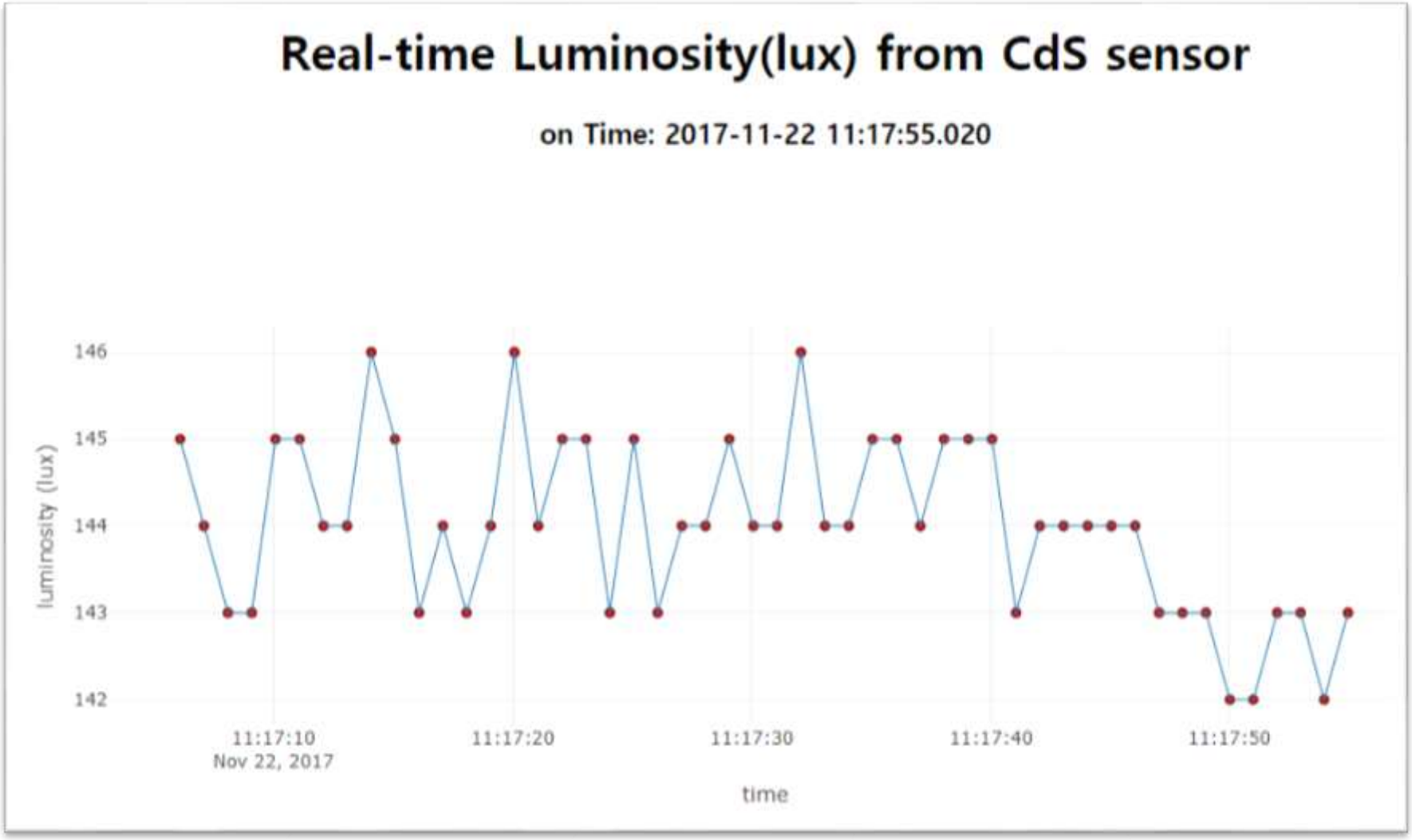
```
// layout
var layout = {
    xaxis : {
        title : 'time',
        domain : [0, 1]
    },
    yaxis : {
        title : 'luminosity (lux)',
        domain : [0, 1],
        range : [0, 500]
    }
};
```

domain: [0,1] → x 또는 y 축을 100% 사용

range: [0,500] → y 축의 범위를 0~500 설정

A5.5.6 RT sensor-data streaming in Arduino

[6] Client html : client_cds.html (real time monitoring of the luminosity)



A5.5.7.1 RT sensor-data streaming in Arduino

[7.1] Client html : client_cds2.html (using plotly streaming without nextPt())

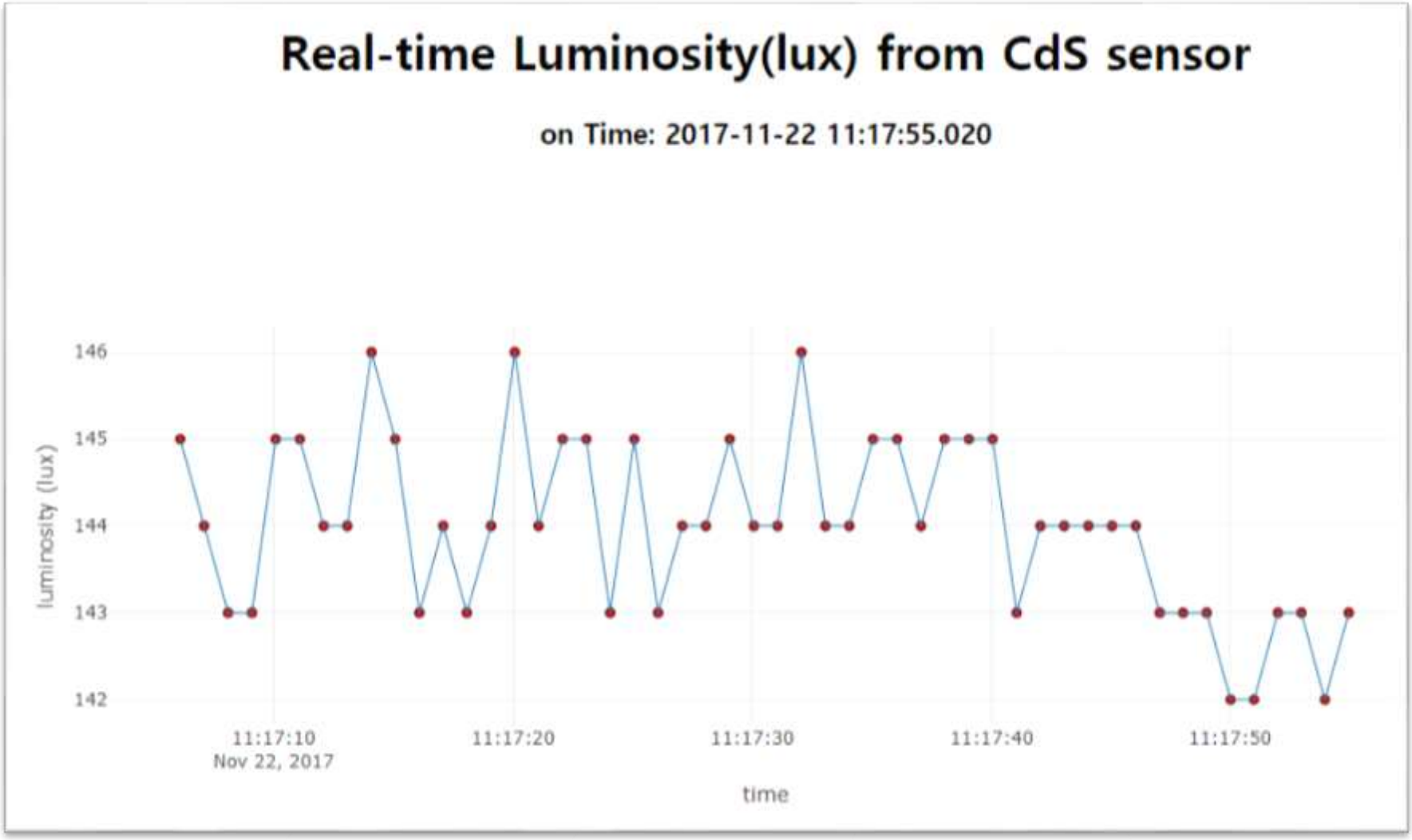
```
/* function nextPt() {

    tArray.shift();
    tArray.push(dtda[0]);

    xTrack.shift();
    xTrack.push(dtda[1]);  //

    Plotly.redraw(streamPlot);
}       */
```

nextPt() 주석 처리

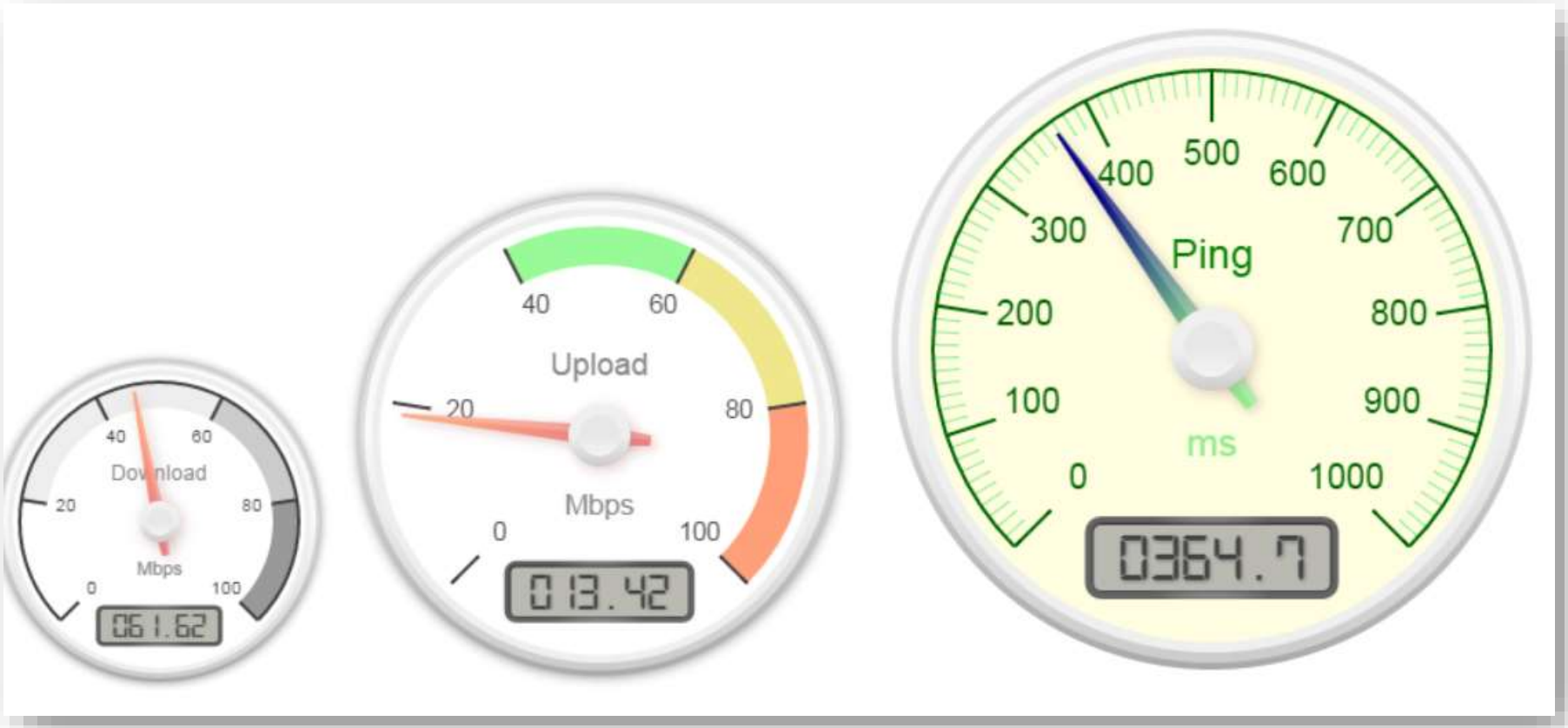
```
socket.on('connect', function () {
    socket.on('message', function (msg) {
        // initial plot
        if(msg[0]!='' && initFlag){
            dtda[0]=msg[0];
            dtda[1]=parseInt(msg[1]);  // lux
            init();  // start streaming
            initFlag=false;
        }
        console.log(msg[0]);
        console.log(parseInt(msg[1])); // Convert
        dtda[0]=msg[0];
        dtda[1] = parseInt(msg[1]);

        // when new data is coming, keep on streami
        ctime.innerHTML = dtda[0];
        //nextPt();
        tArray = tArray.concat(dtda[0]);  // time
        tArray.splice(0,1);
        xTrack = xTrack.concat(dtda[1]);  // lux
        xTrack.splice(0,1);

        var update = {
            x: [tArray],
            y: [xTrack]
        }

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

A5.5.7.2 RT sensor-data streaming in Arduino

[7.2] Client html : client_cds2.html (using plotly streaming without nextPt())



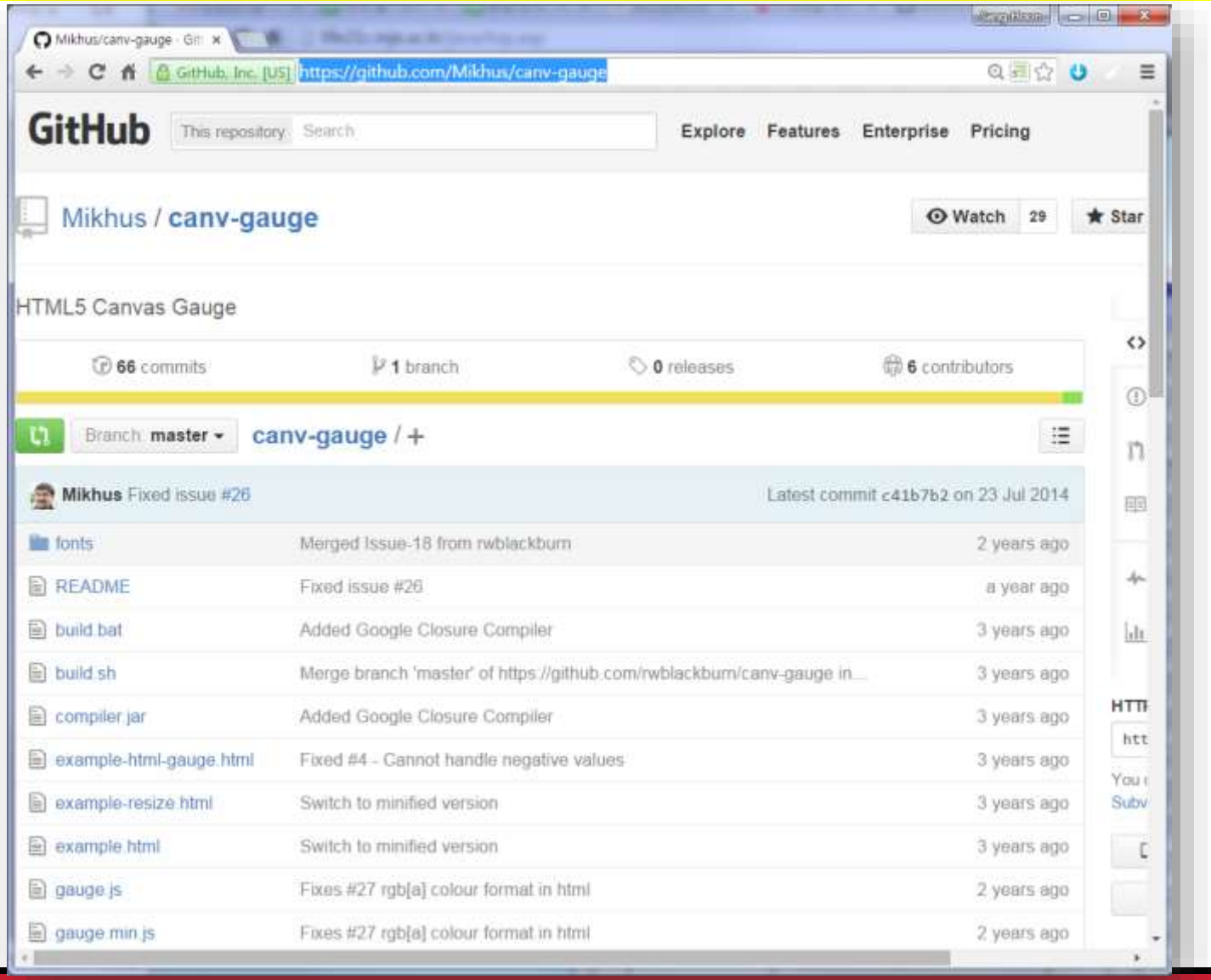
[1] Canvas gauge javascript library : example



http://ru.smart-ip.net/gauge.html

Canvas Gauge

[2] Canvas gauge javascript library : gauge.js



[DIY] Client html : client_cds_gauge.html (add Gauge)

```
<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>
```

```
<body>  <!-- style="width:100%;height:100%"> -->
<!-- Plotly chart will be drawn inside this DIV -->
<h1 align="center"> Real-time Luminosity(lux) from CdS sensor by AAnn</h1>
<!-- Lux gauge -->
<div align="center">
    <canvas id="gauge"> </canvas>
</div>

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

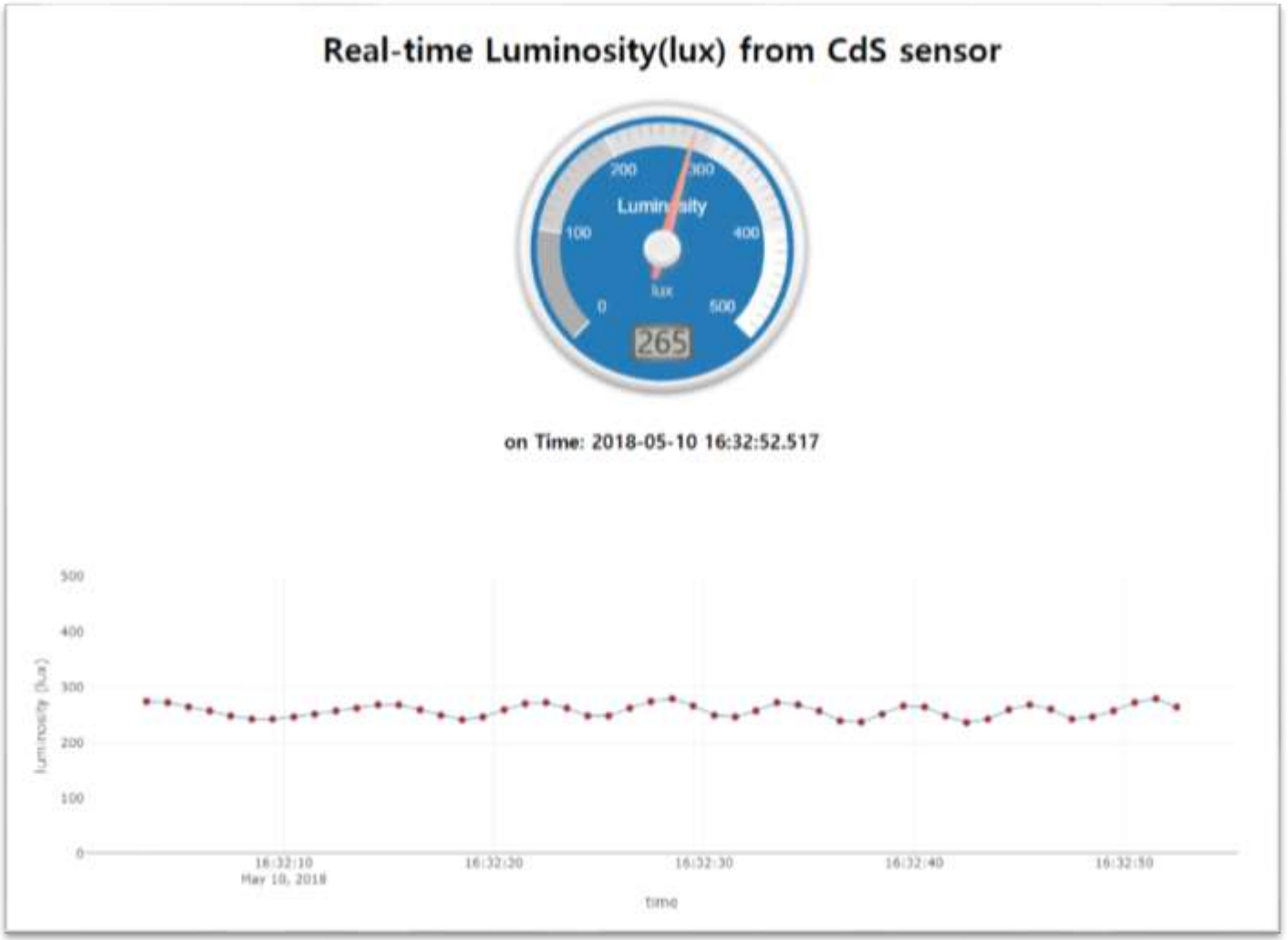
[DIY] Client html : client_cds_gauge.html (add Gauge)

```
socket.on('connect', function () {
    socket.on('message', function (msg) {
        // initial plot
        if(msg[0]!='' && initFlag){
            dtda[0]=msg[0];
            dtda[1]=parseInt(msg[1]);  // lux
            init();  // start streaming
            initFlag=false;
        }
        console.log(msg[0]);
        console.log(parseInt(msg[1])); // Conv
        dtda[0]=msg[0];
        dtda[1] = parseInt(msg[1]);

        // when new data is coming, keep on st
        ctime.innerHTML = dtda[0];
        gauge_lux.setValue(dtda[1]); // lux ga
        //nextPt();
        tArray = tArray.concat(dtda[0]);  // t
        tArray.splice(0,1);
        xTrack = xTrack.concat(dtda[1]);  // l
        xTrack.splice(0,1);

        var update = {
            x: [tArray],
            y: [xTrack]
        }

        Plotly.update(streamPlot, update);

    });
});
```

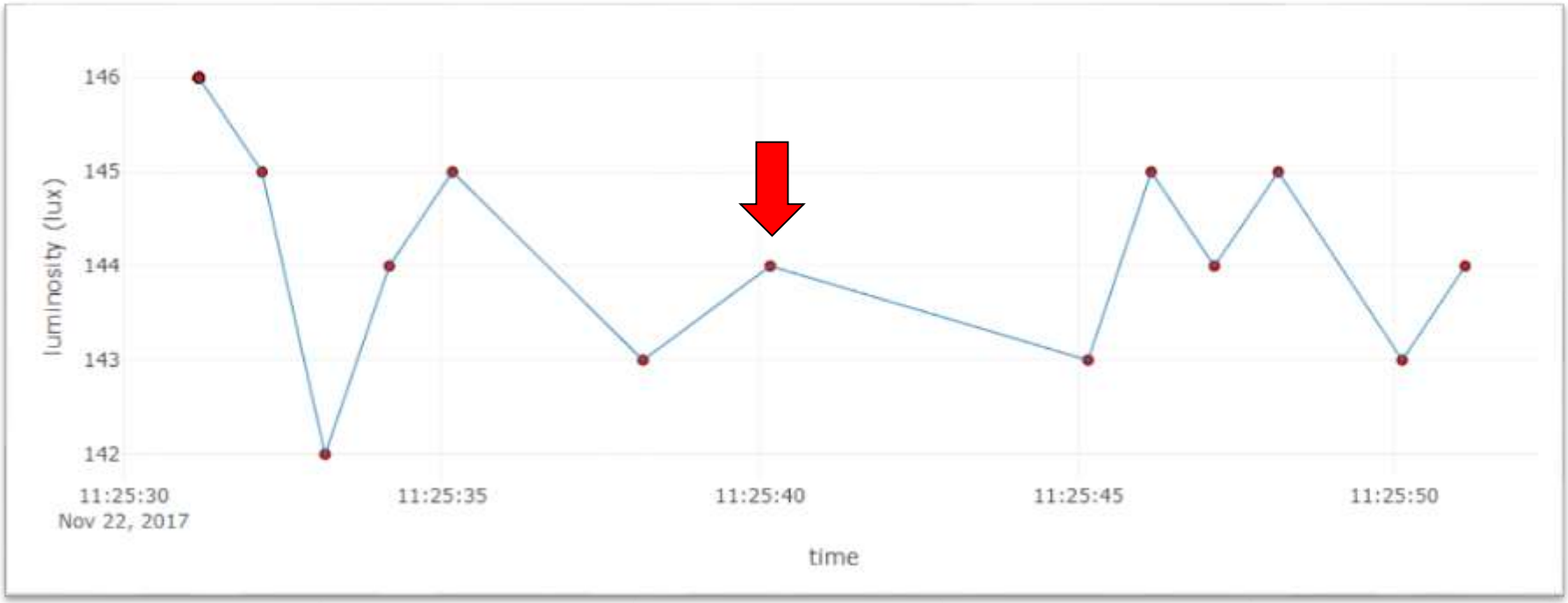
```
var gauge_lux = new Gauge({
    renderTo    : 'gauge',
    width       : 300,
    height      : 300,
    glow        : true,
    units       : 'lux',
    valueFormat : { int : 2, dec : 0 },
    title       : "Luminosity",
    minValue    : 0,
    maxValue    : 500,  // new
    majorTicks  : ['0','100','200','300','400','500'],
    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();
```

[DIY] Client html : client_cds_gauge.html (change design of Gauge)

변경된 디자인으로 된 그래프를 캡처하여 HSnn_cds_gauge.png 로 저장



[DIY] Client html : client_cds_change.html (detecting change)



이상 감지 (anomaly detection)

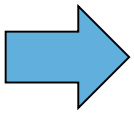
입력되는 lux 값이 변하는 경우에만 그래프를 그림.

실시간 모니터링에서 이상 감지 기능이 필요함.

밝기 값 변화의 문턱값을 설정해서 이상 감지 기능 구현

[DIY. hint] Client html : client_cds_change.html (detecting change)

```
// when new data is coming,
// keep on streaming data
ctime.innerHTML = dtda[0];
gauge_lux.setValue(dtda[1]); // lux gauge
//nextPt();
tArray = tArray.concat(dtda[0]);  // time
tArray.splice(0,1);
xTrack = xTrack.concat(dtda[1]);  // lux
xTrack.splice(0,1);

var update = {
    x: [tArray],
    y: [xTrack]
}

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



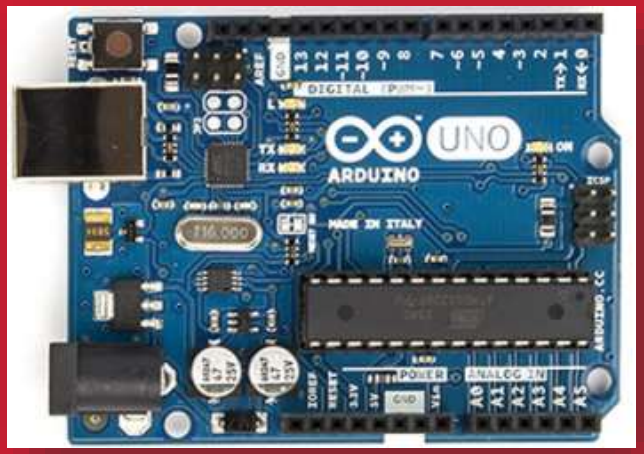
```
// Only when the value of lux is different
// from the previous one, the screen is redrawed.
if (dtda[1] != preX) {  // any change?
    preX = dtda[1];

    ctime.innerHTML = dtda[0];
    gauge_lux.setValue(dtda[1]); // lux gauge
    //nextPt();
    tArray = tArray.concat(dtda[0]);  // time
    tArray.splice(0,1);
    xTrack = xTrack.concat(dtda[1]);  // lux
    xTrack.splice(0,1);

    var update = {
        x: [tArray],
        y: [xTrack]
    }

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

A5.5.9.3 RT sensor-data streaming in Arduino

[DIY] Client html : client_cds_change.html (detecting change)

측정되는 주변광의 밝기가 일정 시간 유지되다가 변하는 그래프를 캡처하여 HSnn_cds_change.png 로 저장

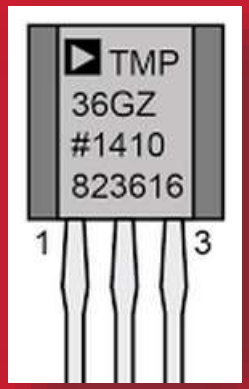
Multiple sensors



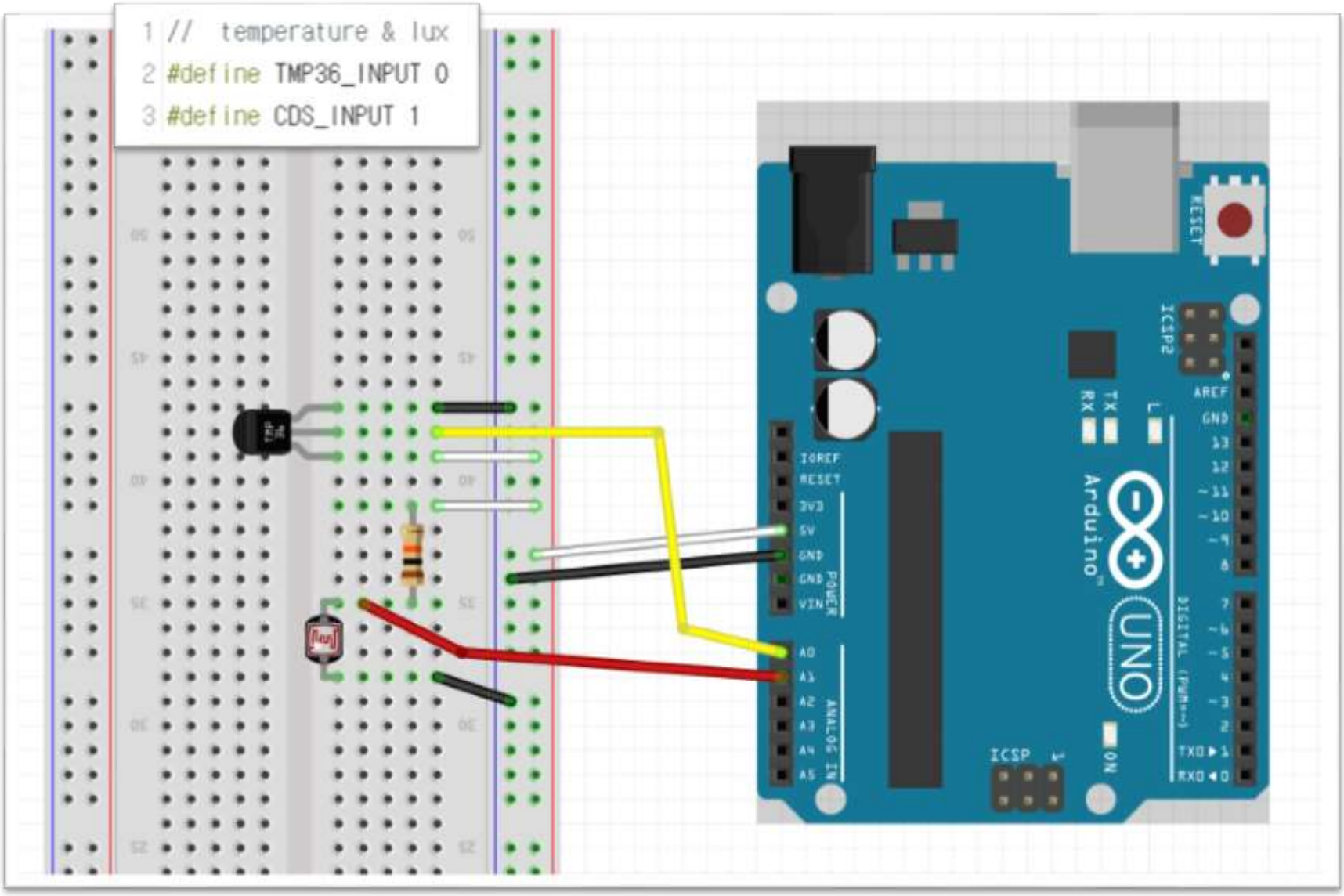
CdS + TMP36

+ plotly.js

Node project



A4.3.1 TMP36 + CdS : circuit



A4.3.2 TMP36 + CdS : code

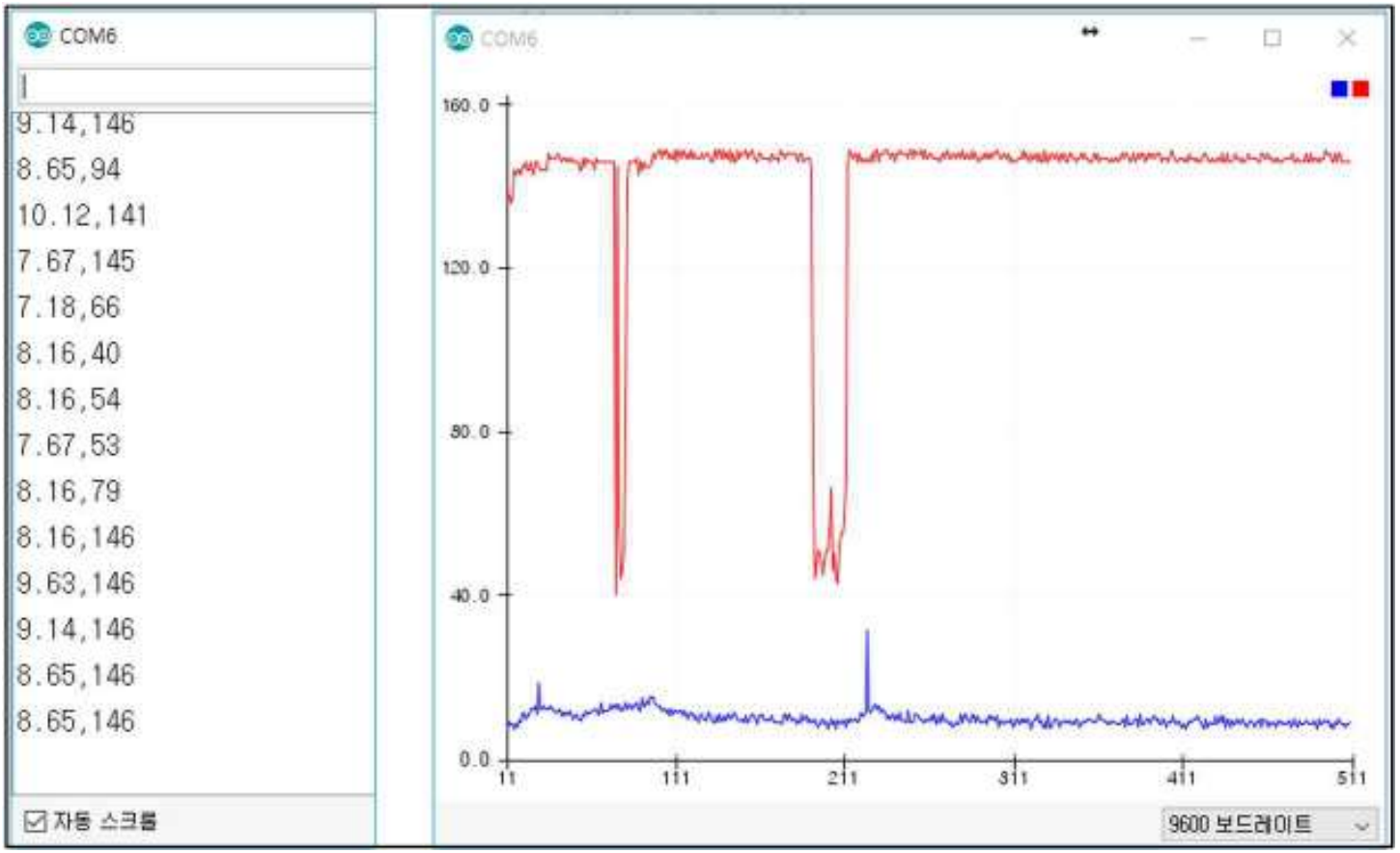
AAnn_TMP36_CdS§

```
1  //  temperature & lux
2  #define TMP36_INPUT 0
3  #define CDS_INPUT 1
4
5  void setup() {
6    Serial.begin(9600);
7  }
```

HSnn_tmp36_cds.ino

```
8  void loop() {
9    // Temperature from TMP36
10   int temp_value = analogRead(TMP36_INPUT);
11   // converting that reading to voltage
12   float voltage = temp_value * 5.0 * 1000;  // in mV
13   voltage /= 1023.0;
14   float tempC = (voltage - 500) / 10 ;
15
16   // Lux from CdS (LDR)
17   int cds_value = analogRead(CDS_INPUT);
18   int lux = int(luminosity(cds_value));
19 //  Serial.print("HSnn,");
20   Serial.print(tempC);
21   Serial.print(",");
22   Serial.println(lux);
23
24   delay(1000);
25 }
26
27 //Voltage to Lux
28 double luminosity (int RawADC0){
29   double Vout=RawADC0*5.0/1023.0;  // 5/1023 (Vin = 5 V)
30   int lux=(2500/Vout-500)/10;
31   // lux = 500 / Rldr, Vout = Ildr*Rldr = (5/(10 + Rldr))*Rldr
32   return lux;
33 }
```

A4.3.2 TMP36 + CdS : result



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": "hsnn"
```

name : cds_tmp36

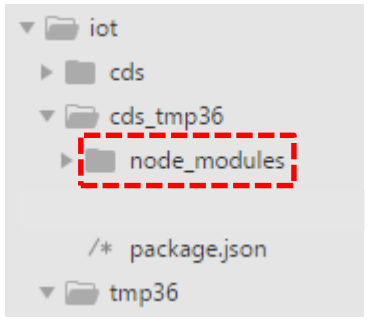
description : cds-tmp36-node project

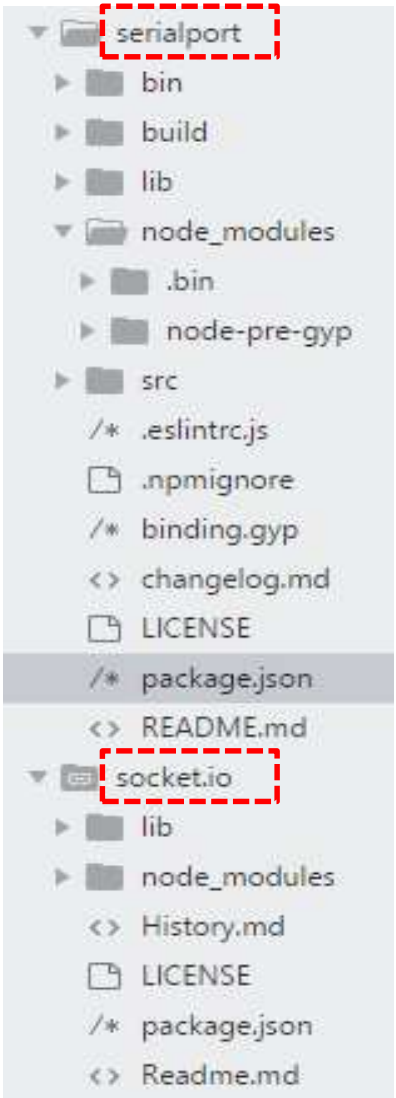
entry point : cds_tmp36_node.js

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**





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**

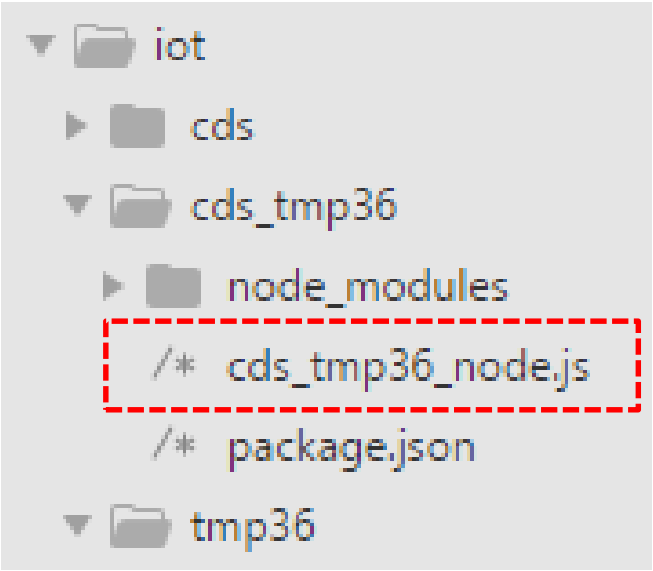
package,json

```
{
  "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"
  },
  "keywords": [
    "cds",
    "tmp36",
    "node"
  ],
  "author": "hs00",
  "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



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

cds_tmp36_node.js

cds_tmp36_node.js

```
1  // cds_tmp36_node.js
2
3  var serialport = require('serialport');
4  var portName = 'COM6';  // check your COM port!!
5  var port     =   process.env.PORT || 3000;
6
7  var io = require('socket.io').listen(port);
8
9  // serial port object
10 var sp = new serialport(portName,{
11     baudRate: 9600,   // 9600  38400
12     dataBits: 8,
13     parity: 'none',
14     stopBits: 1,
15     flowControl: false,
16     parser: serialport.parsers.readline('\r\n')
17 });
```

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

cds_tmp36_node.js – parsing data

```
18 var dStr = '';
19 var readData = '';  // this stores the buffer
20 var temp ='';
21 var lux ='';
22 var mdata =[]; // this array stores date and data from multiple sensors
23 var firstcommaidx = 0;
24
25 sp.on('data', function (data) { // call back when data is received
26     readData = data.toString(); // append data to buffer
27     firstcommaidx = readData.indexOf(',');
28
29     // parsing data into signals
30     if (firstcommaidx > 0) {
31         temp = readData.substring(0, firstcommaidx);
32         lux = readData.substring(firstcommaidx + 1);
33         readData = '';
34
35         dStr = getDateString();
36         mdata[0]=dStr;  // Date
37         mdata[1]=temp;  // temperature data
38         mdata[2]=lux;   // luminosity data
39         console.log("HSnn," + mdata);
40         io.sockets.emit('message', mdata);  // send data to all clients
41
42     } else {  // error
43         console.log(readData);
44     }
45 });
```

Parsing Data

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

cds_tmp36_node.js

```
32 // helper function to get a nicely formatted date string for IOT
33 function getDateString() {
34     var time = new Date().getTime();
35     // 32400000 is (GMT+9 Korea, GimHae)
36     // for your timezone just multiply +/-GMT by 3600000
37     var datestr = new Date(time +32400000).
38     toISOString().replace(/T/, ' ').replace(/Z/, '');
39     return datestr;
40 }
41
42 io.sockets.on('connection', function (socket) {
43     // If socket.io receives message from the client browser then
44     // this call back will be executed.
45     socket.on('message', function (msg) {
46         console.log(msg);
47     });
48     // If a web browser disconnects from Socket.IO then this callback is called.
49     socket.on('disconnect', function () {
50         console.log('disconnected');
51     });
52 });
```

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

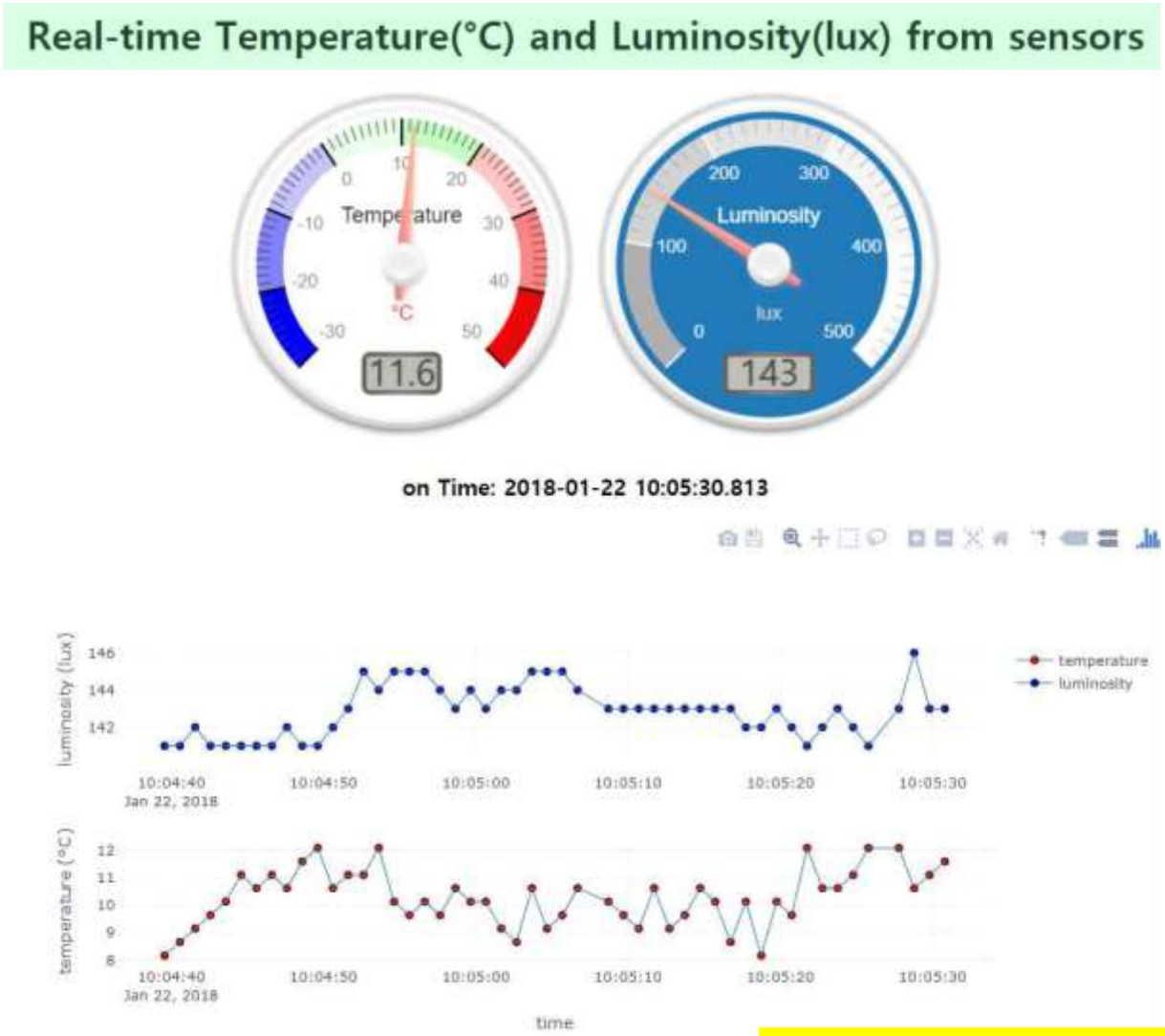
[DIY] Client html : client_cds_tmp36.html (data from multi sensors)

```
// 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();
```

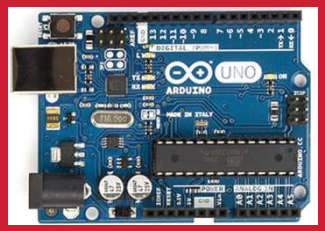
```
var gauge_lux = new Gauge({
    renderTo    : 'gauge2',
    width       : 300,
    height      : 300,
    glow        : true,
    units       : 'lux',
    valueFormat : { int : 3, dec : 0 },
    title       : "Luminosity",
    minValue    : 0,
    maxValue    : 500,  // new
    majorTicks  : ['0','100','200','300','400','500'],
    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

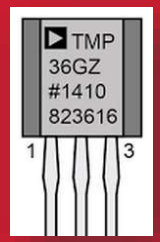
[DIY] Client html : client_cds_tmp36.html (result)

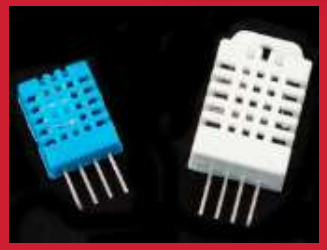


HSnn_DS_cds_tmp36.png 로 저장



[Practice]





- [wk10]
  - RT Data Visualization with node.js
  - Usage of gauge.js
  - Complete your real-time WEB charts
  - Upload file name : HSnn_Rpt08.zip

[wk10] Practice-08 HSnn_Rpt08.zip

- **[Target of this week]**
  - Complete your charts
  - Save your outcomes and compress them.

제출파일명 : **HSnn_Rpt08.zip**

- 압축할 파일들

① HSnn_DS_30timestamps.png

② HSnn_DS_multiple_axis.png

③ HSnn_cds_gauge.png

④ HSnn_cds_change.png

⑤ HSnn_DS_cds_tmp36.png

Email : chaos21c@gmail.com

[제목 : id, 이름 (수정)]

Lecture materials

References & good sites

- ✓ http://www.nodejs.org/ko Node.js
- ✓ http://www.arduino.cc Arduino Homepage
- ✓ http://www.w3schools.com By w3schools
- ✓ http://www.github.com GitHub
- ✓ http://www.google.com Googling

Github.com/Redwoods

GitHub, Inc. [US] | https://github.com Redwoods (Redwoods Yi) - GitHub

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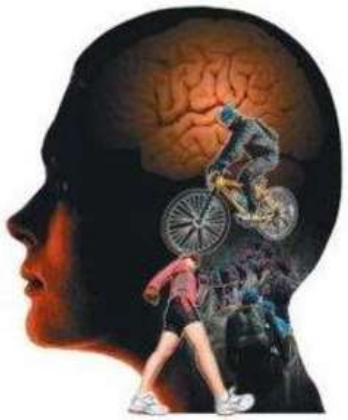

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GimHae, Republic of Korea

Overview Repositories 5 Stars 2 Followers 0 Following 0

Pinned repositories

dht22-iot-project

Iot project to monitor data streaming from DHT22 wired at Arduino.

HTML

Lec

All lectures by Redwoods in Inje University

arduino-nodejs-plotly-streaming

This repo introduces a simple and efficient way to plot the streaming data from Arduino with Easy Pulse ppg sensor or DHT11 sensor.

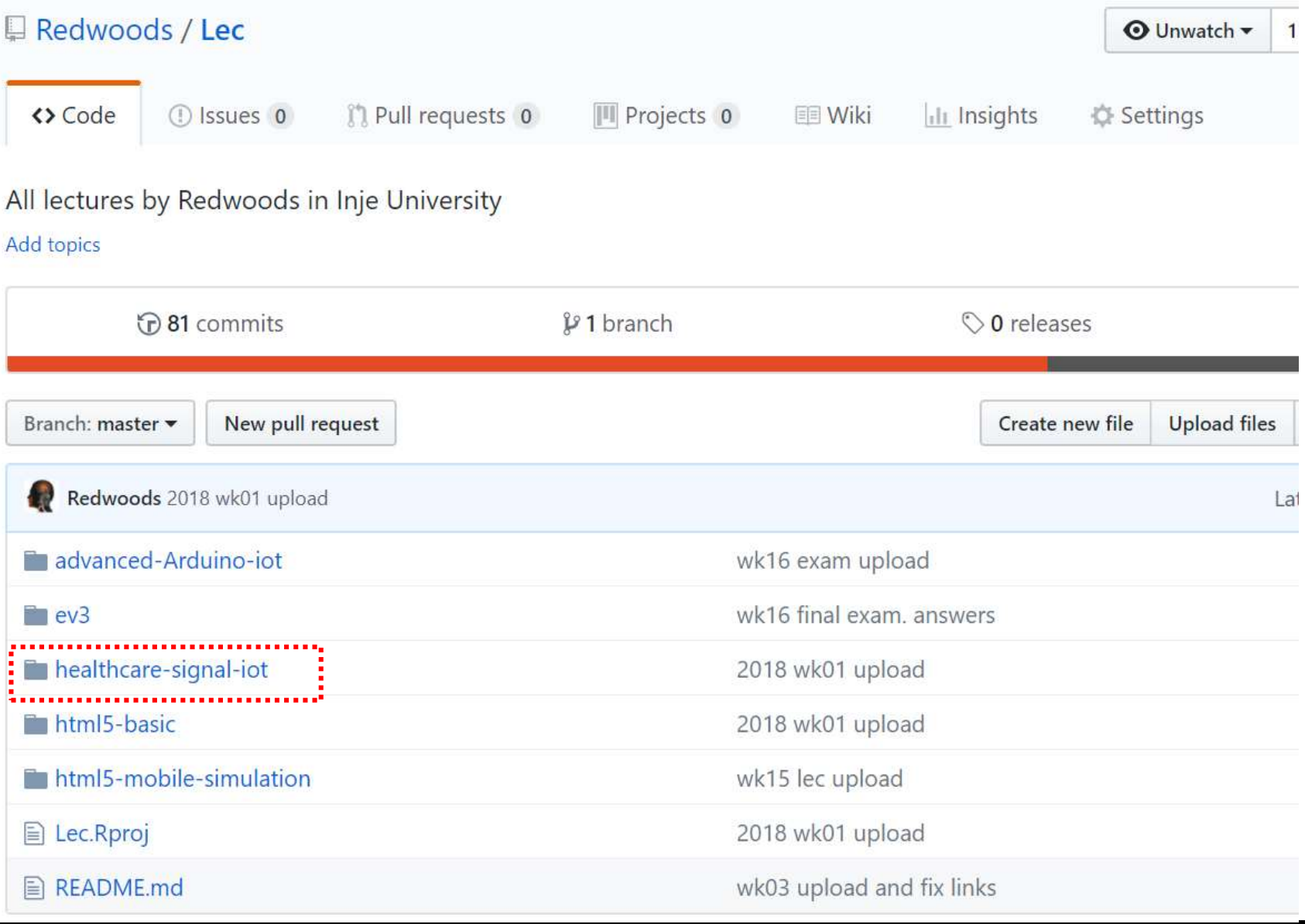
HTML

hw-coding

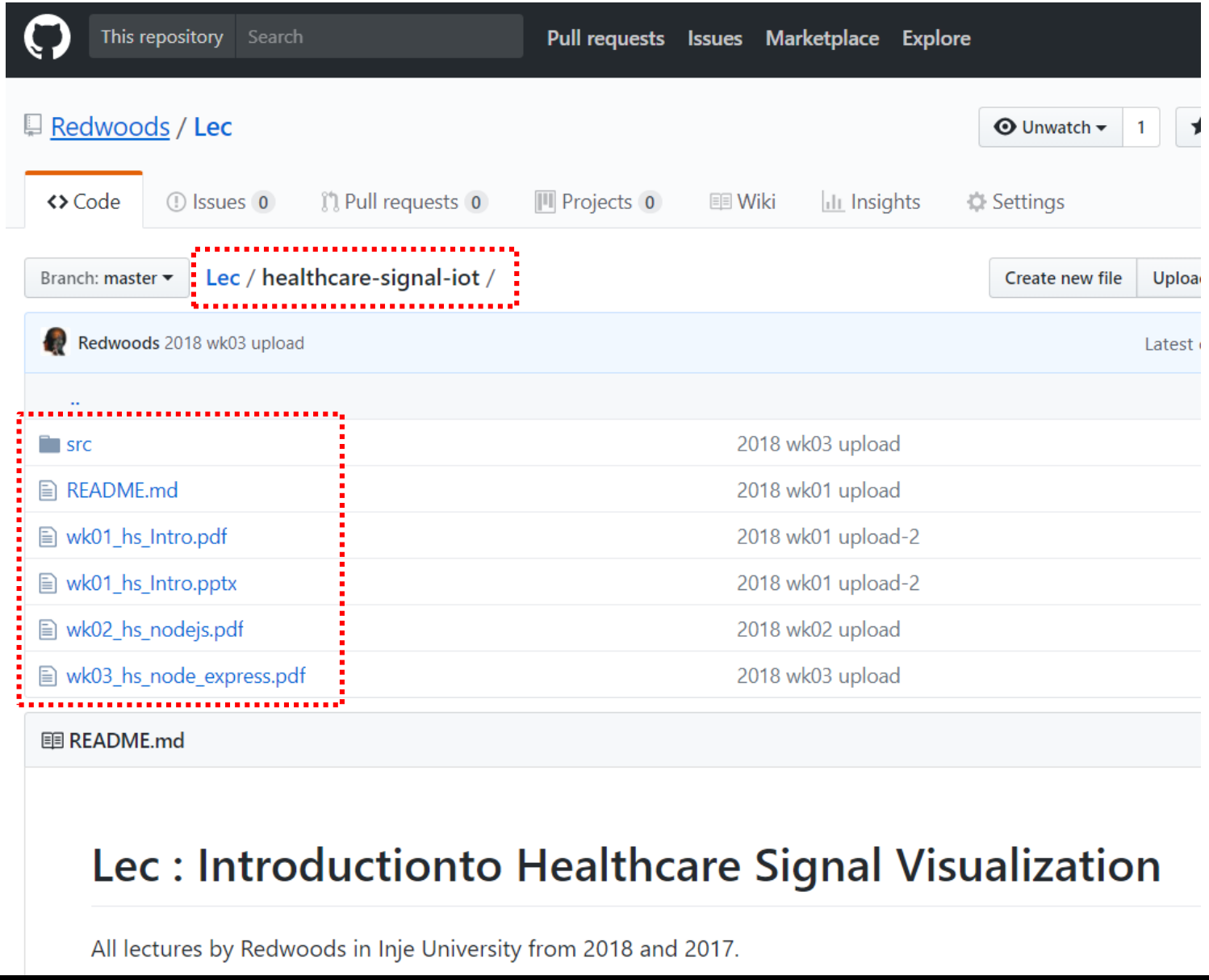
Resource for lecture of Hardware Programming (2017, Inje university)

Arduino

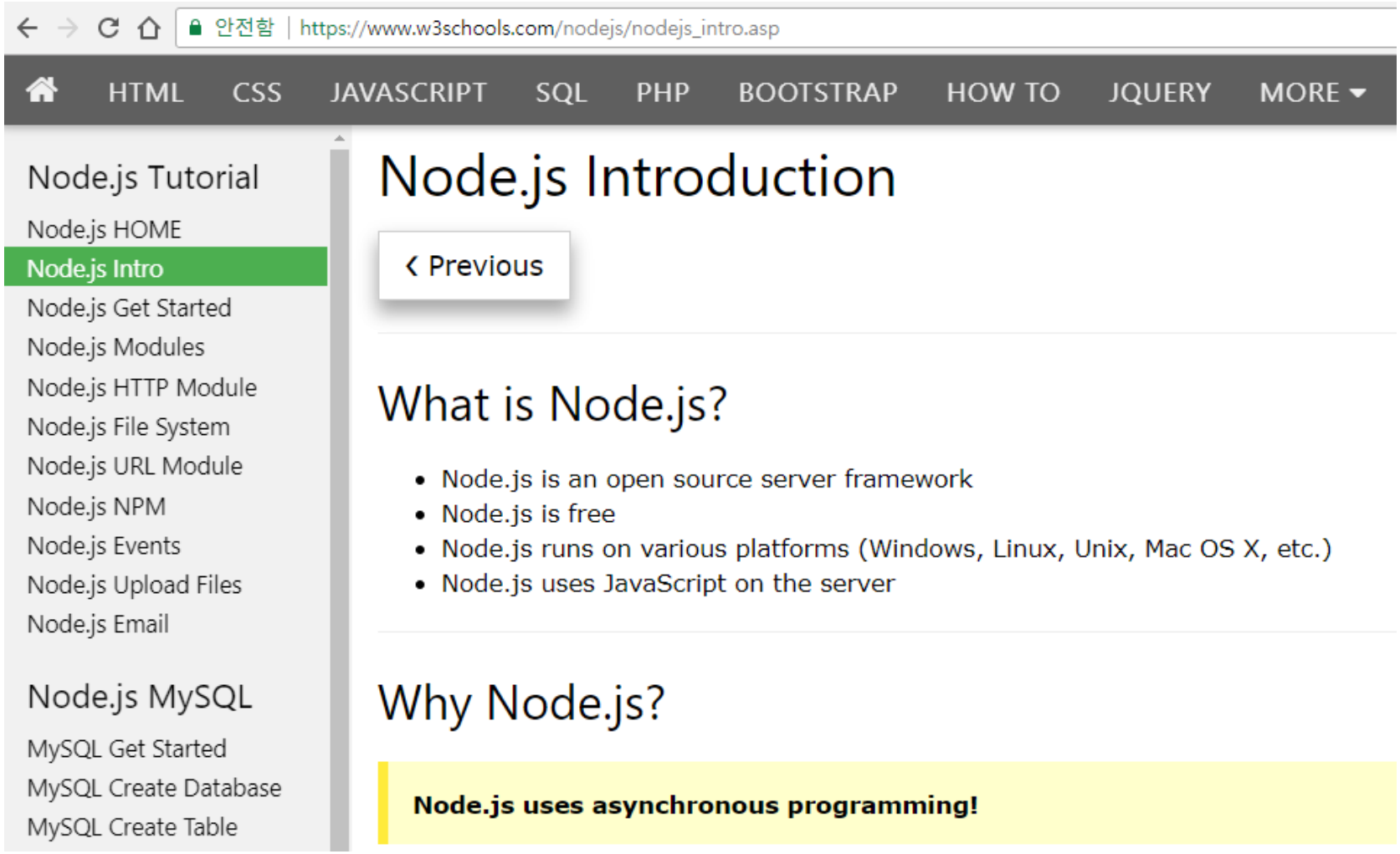
Github.com/Redwoods/healthcare-signal-iot



Github.com/Redwoods/healthcare-signal-iot

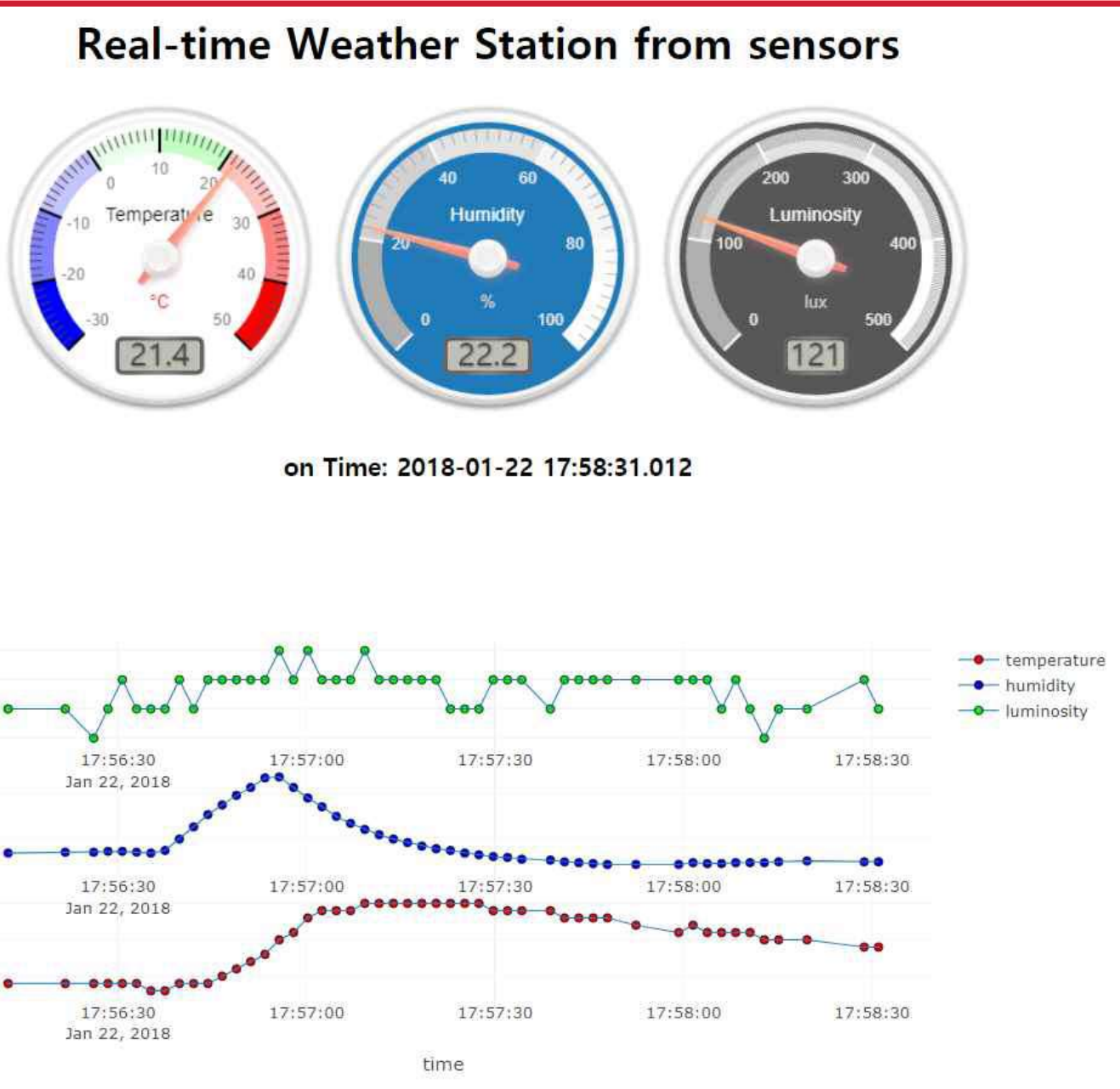


1.0 What is node.js?

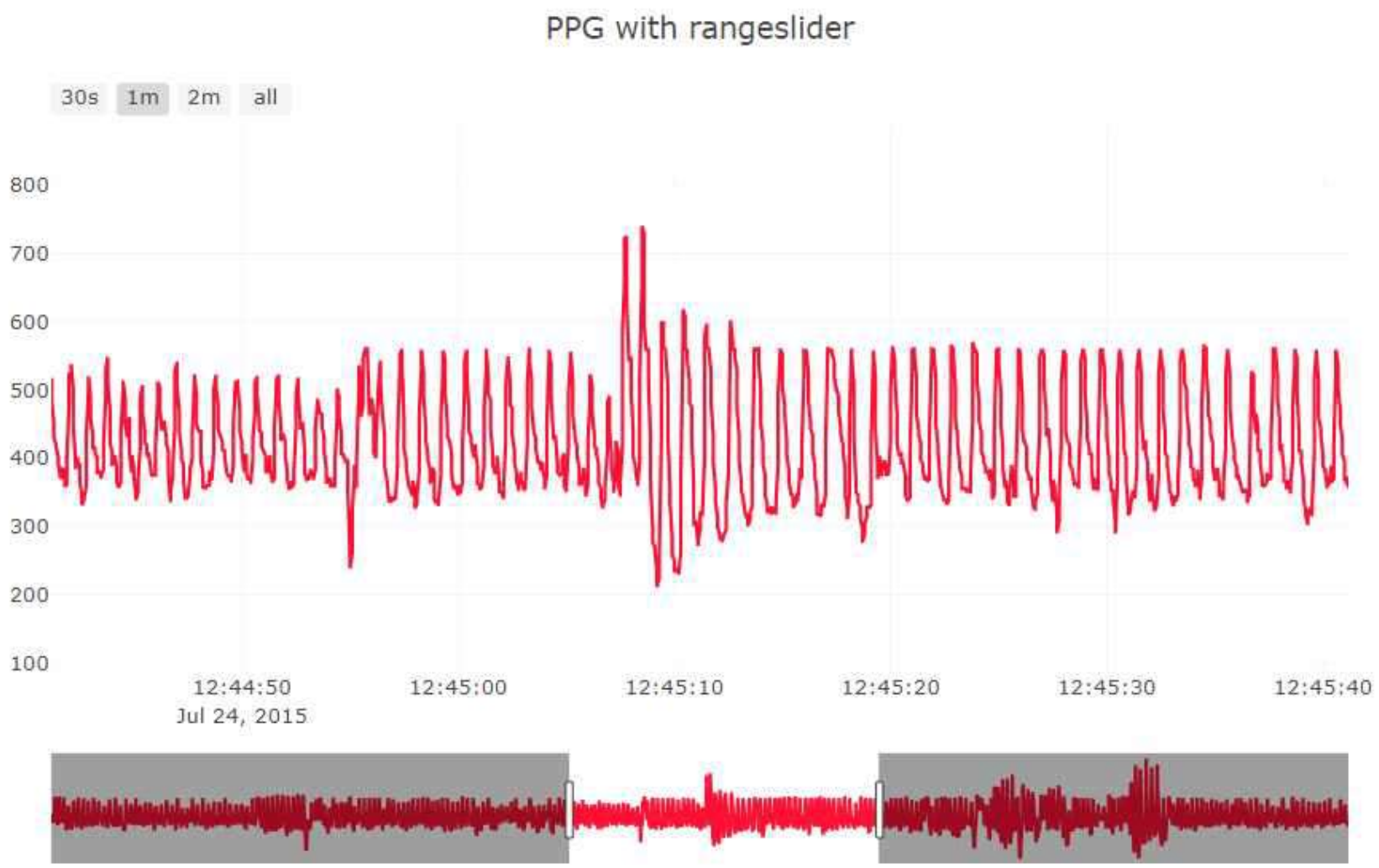


https://www.w3schools.com/nodejs/nodejs_intro.asp

Target of this class



Project of this class



주교재