

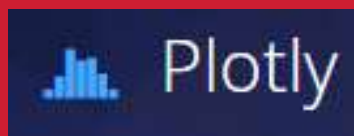
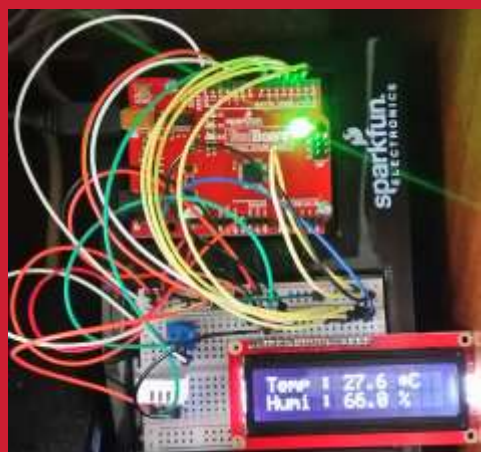


Arduino-IoT

[wk07]

Data Visualization II - plotly.js + node

Visualization of Signals using Arduino,
Node.js & storing signals in MongoDB
& mining data using Python



Drone-IoT-Comsi, INJE University

2nd semester, 2022

Email : chaos21c@gmail.com



My ID

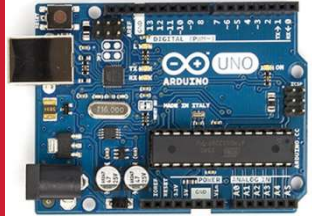
ID를 확인하고 github에 repo 만들기

AA01	강대진	AA13	박제홍
		AA14	심준혁
AA03	김성우	AA15	이상혁
AA04	김정현	AA16	이승무
		AA17	이승준
AA06	김창연	AA18	이준희
AA07	김창욱	AA19	이현준
AA08	김태화	AA20	임태형
AA09	남승현	AA21	정동현
AA10	류재환		
AA11	박세훈	AA23	정희서
AA12	박신영	AA24	최재형

위의 id를 이용해서 github에 repo를 만드시오.

Option: 아두이노응용 실습 과제 - AAnn

Public, README.md check



[Review]

◆ [wk06]

- charts by plotly
- Complete your project
- Upload folder: aann-rpt07
- Use repo “aann” in github

wk06 : Practice : aann-rpt07

◆ [Target of this week]

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

제출폴더명 : **aann-rpt07**

- 압축할 파일들

- ① **AAnn_Chart_Layout.png**
- ② **AAnn_Axis_Title.png**
- ③ **AAnn_Line_Dash_Dot.png**
- ④ **AAnn_lux_Time_Series.png**
- ⑤ **AAnn_lux_Rangeslider.png**
- ⑥ **All *.html in data_charts folder**

Purpose of AA

주요 수업 목표는 다음과 같다.

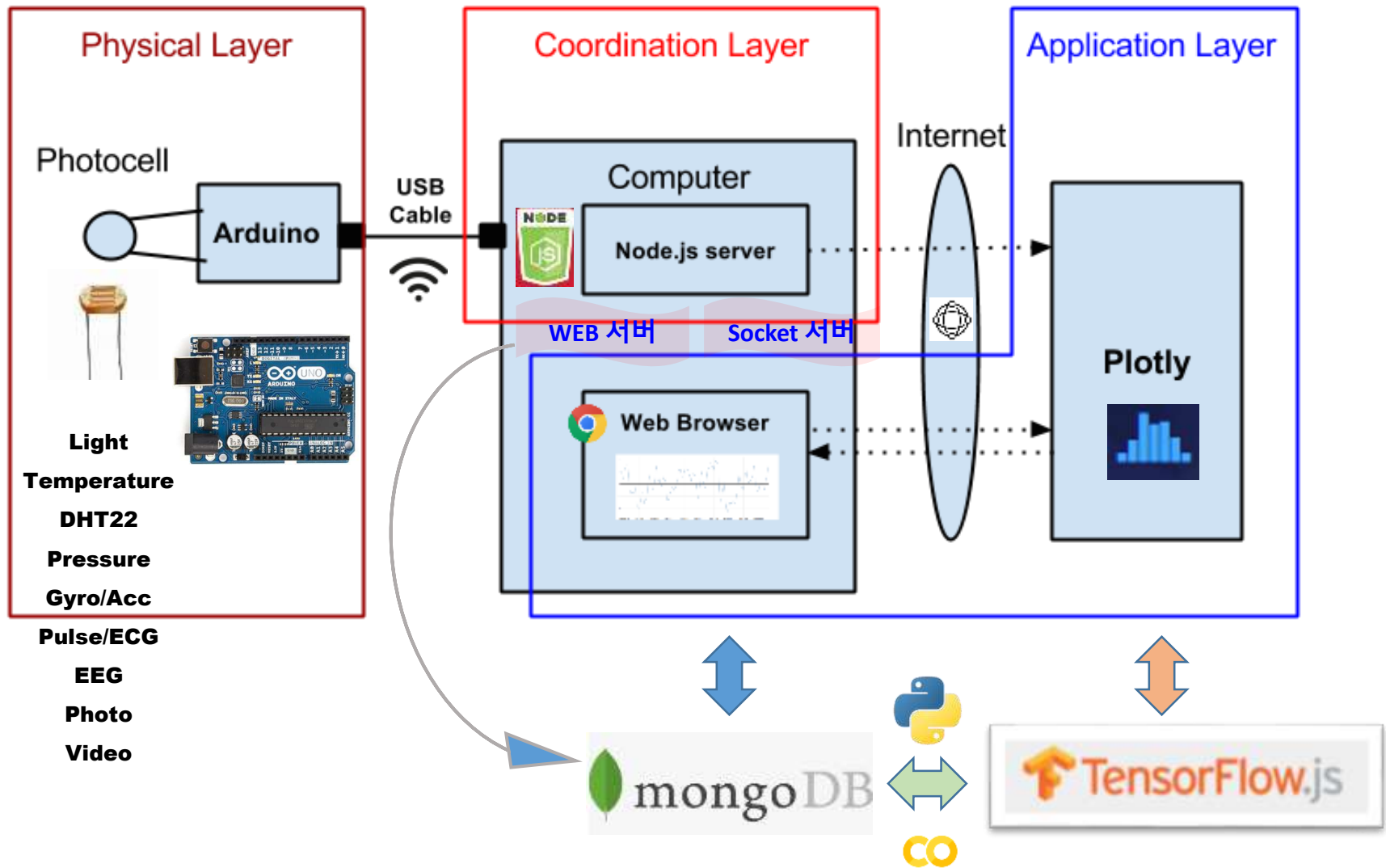
1. Node.js를 이용한 아두이노 센서 신호 처리
2. Plotly.js를 이용한 아두이노 센서 신호 시각화
3. MongoDB에 아두이노 센서 데이터 저장 및 처리



4. 저장된 IoT 데이터의 마이닝 (파이썬 코딩)

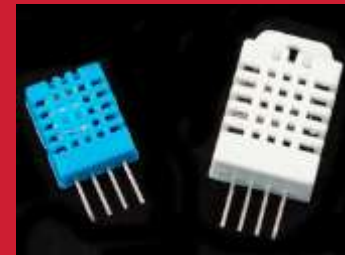
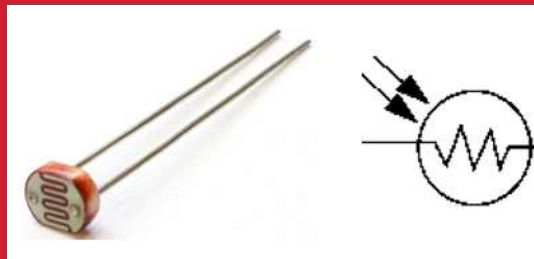
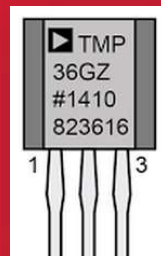
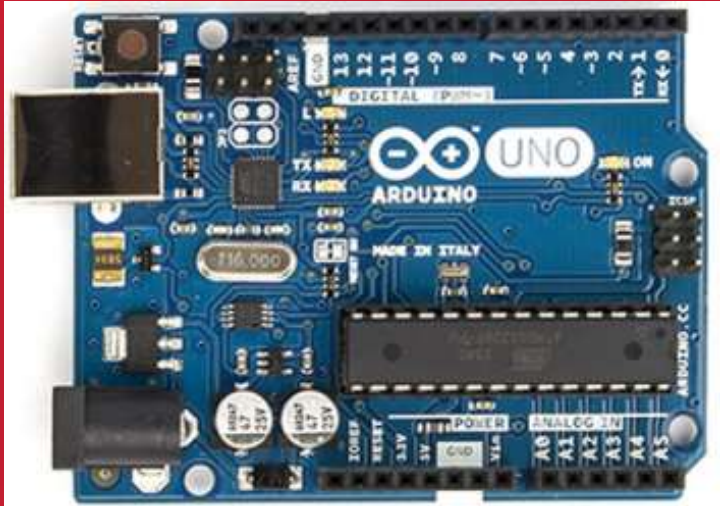


Layout [H S C]





Arduino Sensors + Node.js



on WEB monitoring Arduino data

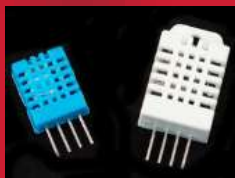
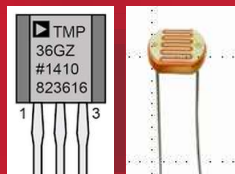
IoT Signal from Arduino

Real-time Signals

on Time: 2021-10-06 09:49:49.818

Signals (조도, 습도, 온도) : 166,60,-5

http://chaos.inje.ac.kr:3030/iot_multi.html

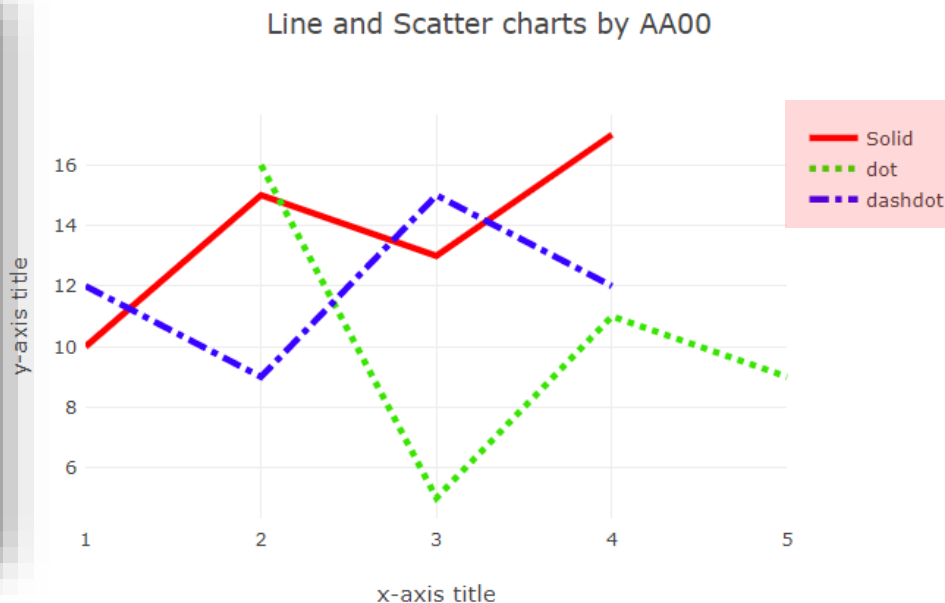


[3.5] Line & scatter plot with dash and dot

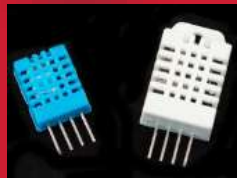
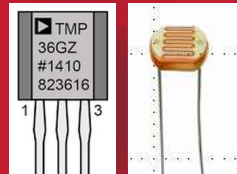
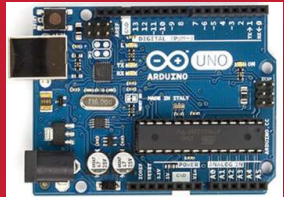
```
var trace1 = {
  x: [1, 2, 3, 4],
  y: [10, 15, 13, 17],
  mode: 'lines',
  name: 'Solid',
  line: {
    color: 'rgb(255, 0, 0)',
    dash: 'solid',
    width: 4
  }
};
```

```
var trace2 = {
  x: [2, 3, 4, 5],
  y: [16, 5, 11, 9],
  mode: 'lines',
  name: 'dot',
  line: {
    color: 'rgb(55, 228, 0)',
    dash: 'dot',
    width: 4
  }
};
```

```
var trace3 = {
  x: [1, 2, 3, 4],
  y: [12, 9, 15, 12],
  mode: 'lines',
  name: 'dashdot',
  line: {
    color: 'rgb(55, 0, 255)',
    dash: 'dashdot',
    width: 4
  }
};
```



AAnn_Line_Dash_Dot.png



Data visualization using **plotly.js**





Project: Time series with Rangelslider

[Project-DIY] AAnn_lux_Rangelslider.html



AAnn_lux_Rangelslider.png

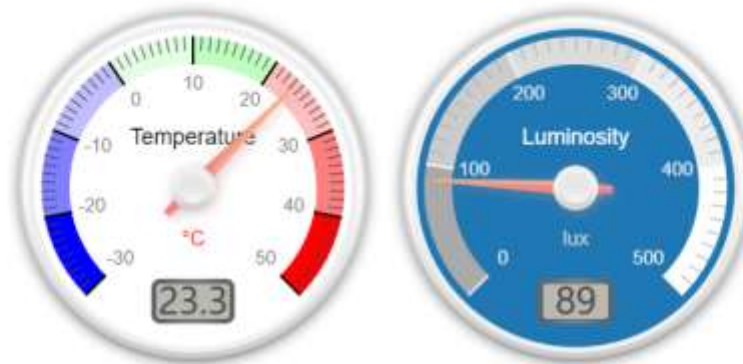


Time series with Rangeslider

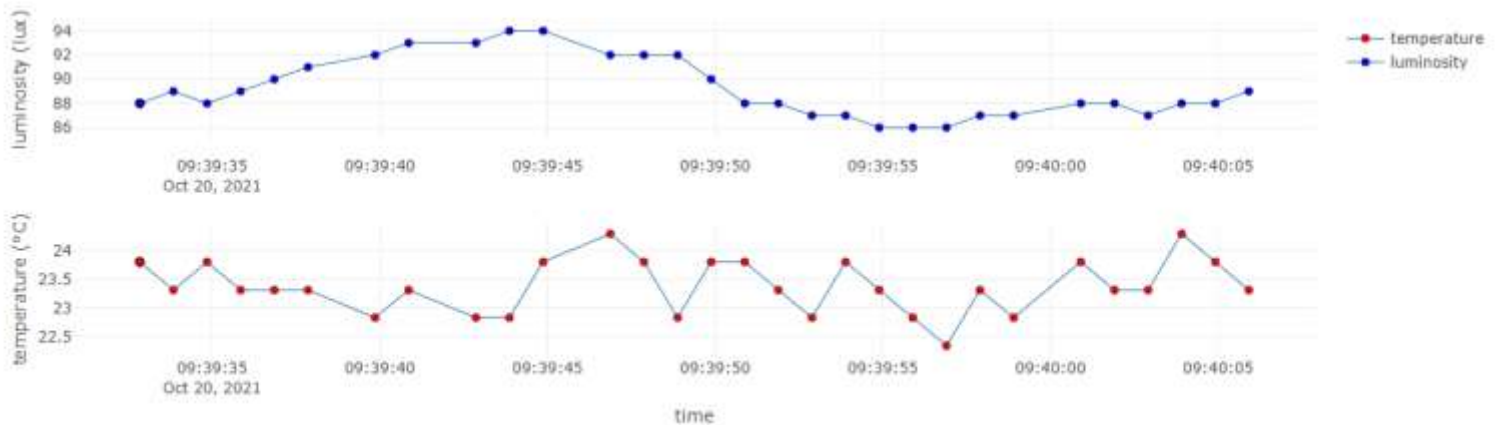
```
var layout = {  
  title: 'lux time series by AA00',  
  width: 750, height: 500,  
  margin: {  
    l: 50,  
    r: 50,  
    b: 100,  
    t: 100,  
    pad: 4  
  },  
  xaxis: {  
    title: 'date',  
    autorange: true,  
    range: ['2015-11-05 12:09:40.383', '2015-11-05 12:10:30.413'],  
    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: 'data: lux'  
  }  
};
```

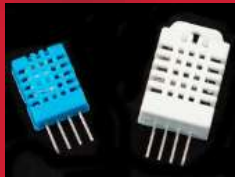
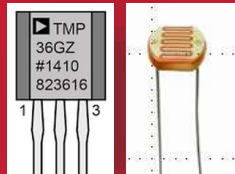
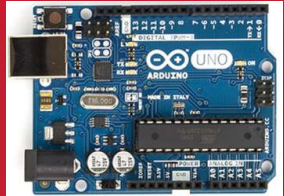
Arduino data + plotly + gauge.js

Real-time Temperature($^{\circ}\text{C}$) and Luminosity(lux) from sensors



on Time: 2021-10-20 09:40:05.918

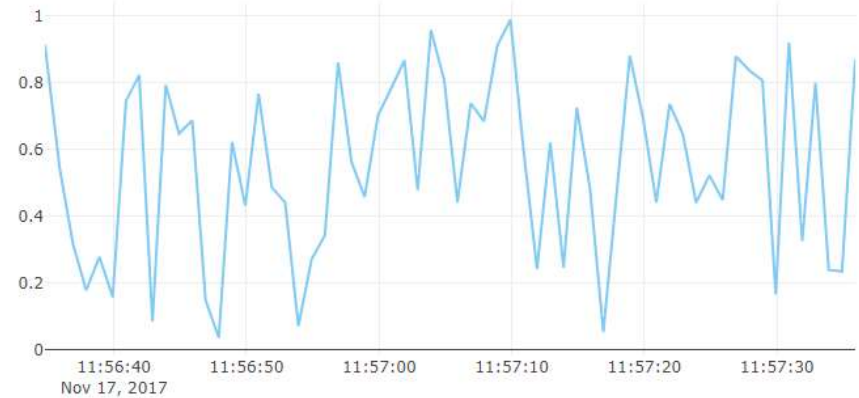




Data Streaming using **plotly.js**



Streaming data with timestamp





A5.4 plotly.js: Streaming data

Plot.ly > Streaming

The screenshot shows the Plot.ly website interface. At the top, there's a navigation bar with the Plot.ly logo, links for "Developer Support", "PLOTCON", and "Consulting", and a hamburger menu icon. Below this is a blue banner. A secondary navigation bar contains links for "Help", "API Libraries", "Plotly.js", and "Streaming", along with a "Fork on Github" button. On the left, a "Navigation" sidebar lists various topics, with "Basic Streaming" highlighted. The main content area is titled "Streaming in plotly.js" and includes a sub-header "How to create D3.js-based streaming plots in Plotly.js." Below this, there are two buttons: one for "R" and one for "JS plotly.js". At the bottom, a link for "Basic Streaming" is visible with an external link icon.

plotly Developer Support PLOTCON Consulting

Help API Libraries Plotly.js Streaming Fork on Github

Navigation

- [Basic Streaming](#)
- Multiple Traces
- Streaming with Timestamp
- Extend Traces Relayout
- 30 Points Using Update
- Streaming Subplots

Streaming in plotly.js

How to create D3.js-based streaming plots in Plotly.js.

R JS plotly.js

[Basic Streaming](#)



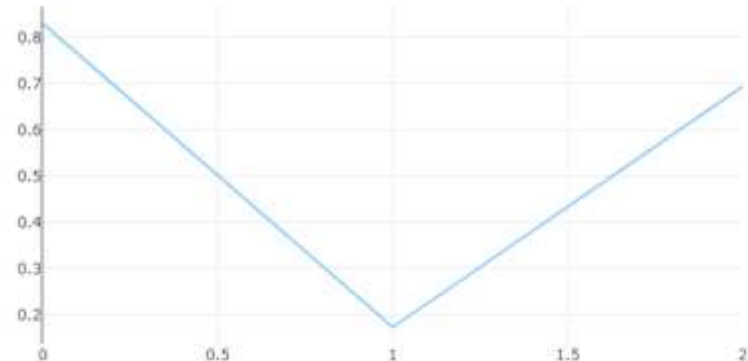
A5.4.1 plotly.js: Streaming data

[1.0] Starting chart

```
<h2>Hello streaming!</h2>
<div id="graph"></div>
<script>
  function rand() {
    return Math.random();
  }
  trace = {
    y: [1, 2, 3].map(rand),
    mode: "lines",
    line: { color: "#80CAF6" },
  };
  data = [trace];
  Plotly.newPlot("graph", data);

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

Hello streaming!



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)

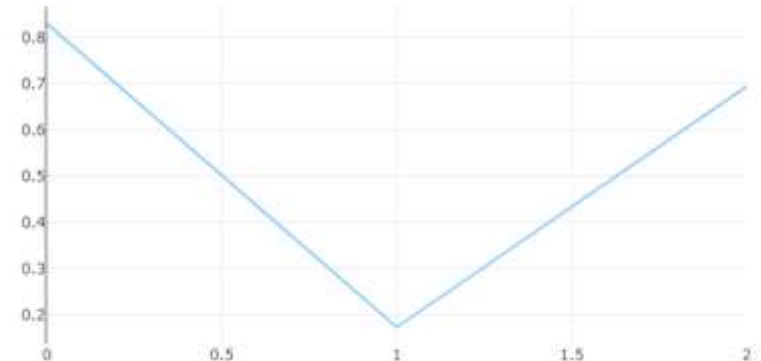
DV_streaming01.html

```
<h2>Hello streaming!</h2>
<div id="graph"></div>
<script>
  function rand() {
    return Math.random();
  }

  Plotly.newPlot("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>
```

Hello streaming!

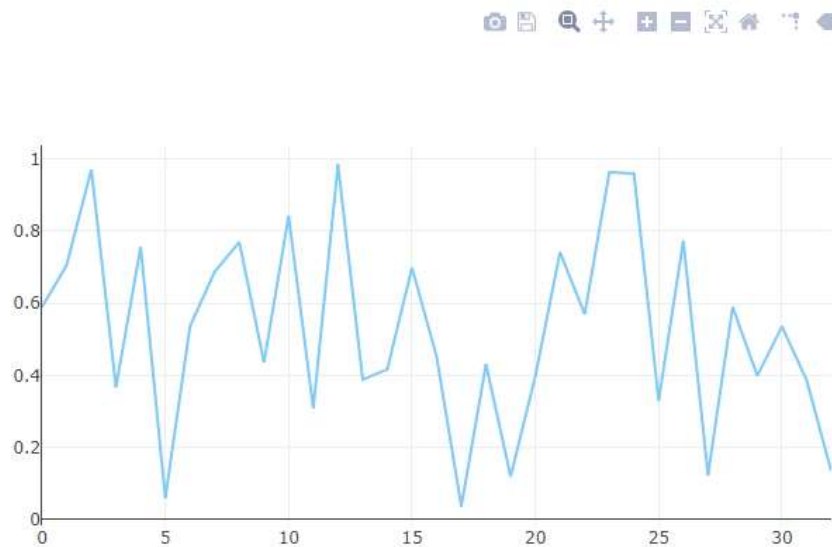


[1.2] Basic streaming

DV_streaming01S.html

```
<h2>Streaming data!</h2>
<div id="graph"></div>
<script>
  function rand() {
    return Math.random();
  }
  Plotly.newPlot("graph", [
    {
      y: [1, 2, 3].map(rand),
      mode: "lines",
      line: { color: "#80CAF6" },
    },
  ]),
  cnt = 0;
  var interval = setInterval(function () {
    cnt++;
    Plotly.extendTraces(
      "graph",
      {
        y: [[rand()]],
      },
      [0]
    );
    if (cnt == 30) clearInterval(interval);
  }, 2000);
</script>
```

Streaming data!





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;
```

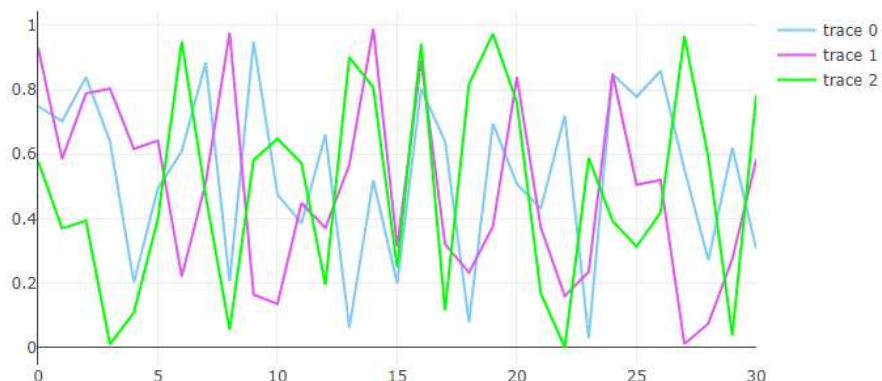
```
var interval = setInterval(function() {
```

```
    Plotly.extendTraces('graph', {
```

```
        y: [[rand()], [rand()], [rand()]]  
    }, [0, 1, 2])
```

```
    cnt++;
```

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





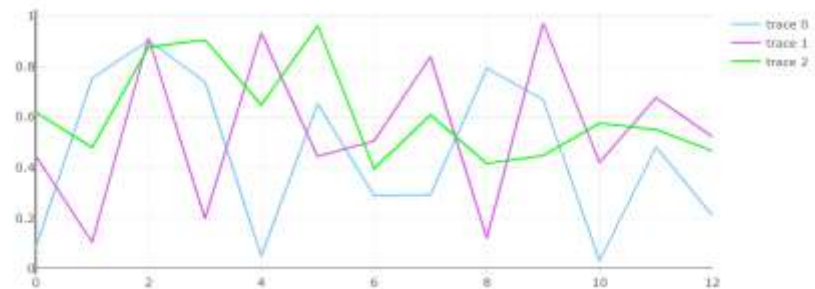
A5.4.3.2 plotly.js: Streaming data

[2.2] Streaming multiple traces (new code) [DV_streaming02.html](#)

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

Hello multiple streaming!





A5.4.4 plotly.js: Streaming data

[3] Streaming data with timestamp [DV_streaming03_timestamp.html](#)

```
function rand() {  
    return Math.random();  
}  
  
var time = new Date();  
var data = [  
    {  
        x: [time],  
        y: [rand()],  
        mode: "lines",  
        line: { color: "#80CAF6" },  
    },  
];  
Plotly.newPlot("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);
```

Timestamp data streaming



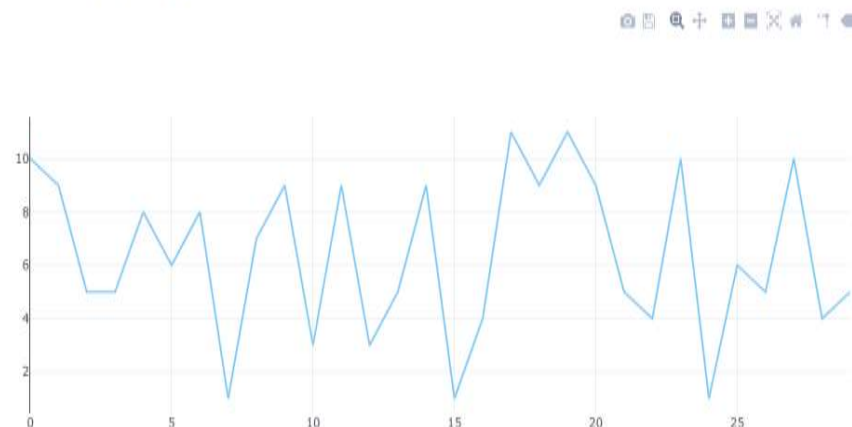
[4] Streaming data using 30 points update

```
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.newPlot("graph", data);
```

```
var cnt = 0;
var interval = setInterval(function () {
    var y = Math.round(Math.random() * 10) + 1;
    newArray = newArray.concat(y); // add new data
    newArray.splice(0, 1); //remove the oldest data
    var update = {
        y: [newArray],
    };
    Plotly.update("graph", update);
    cnt++;
    if (cnt === 50) clearInterval(interval);
}, 1000);
```

DV_streaming04_range_START.html

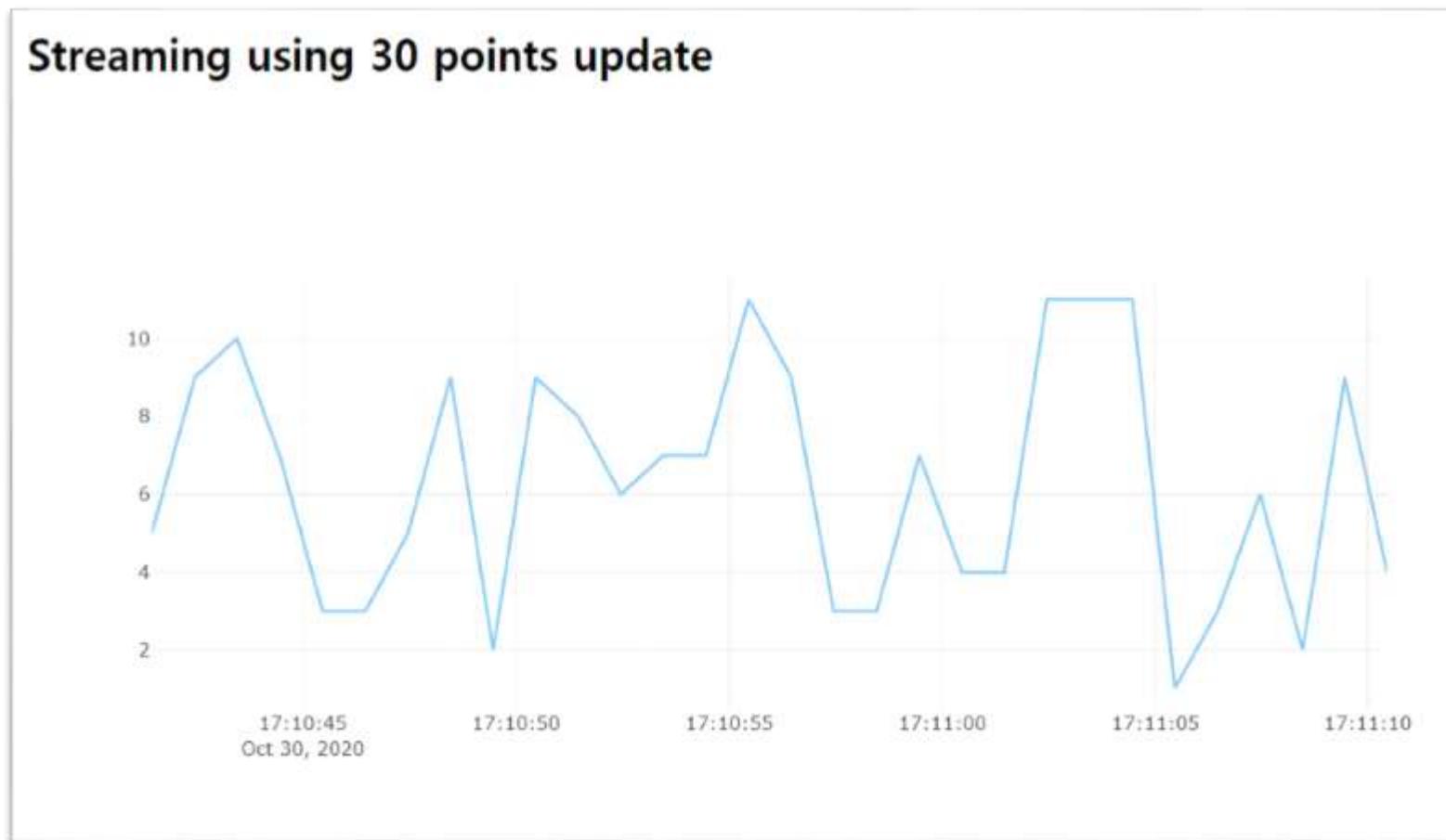
Streaming using 30 points update





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

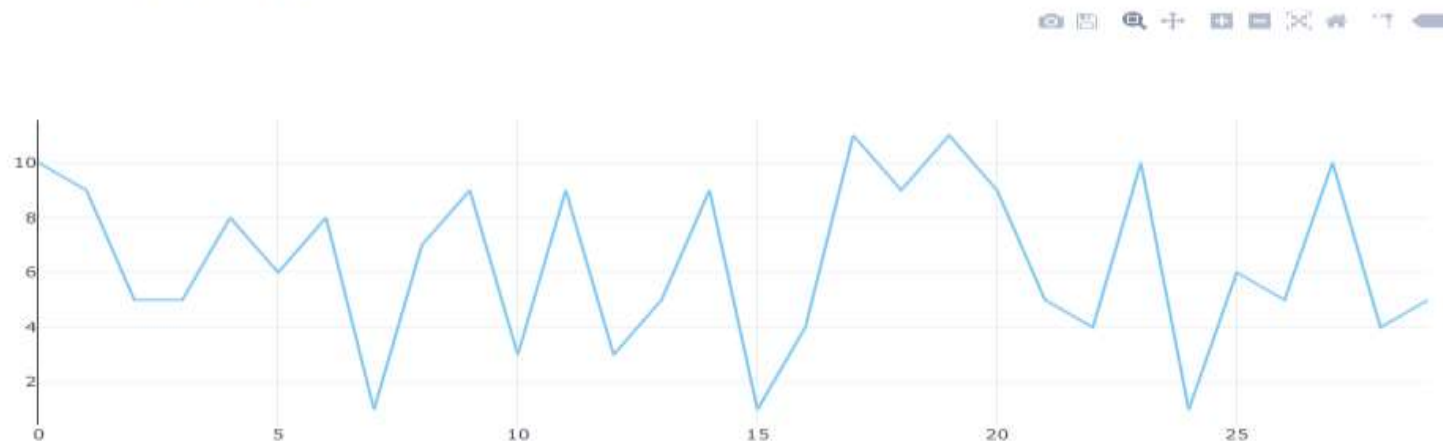
[4.2] Streaming data using 30 points update [DV_streaming04_range.html](#)

```
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.newPlot("graph", data);
```

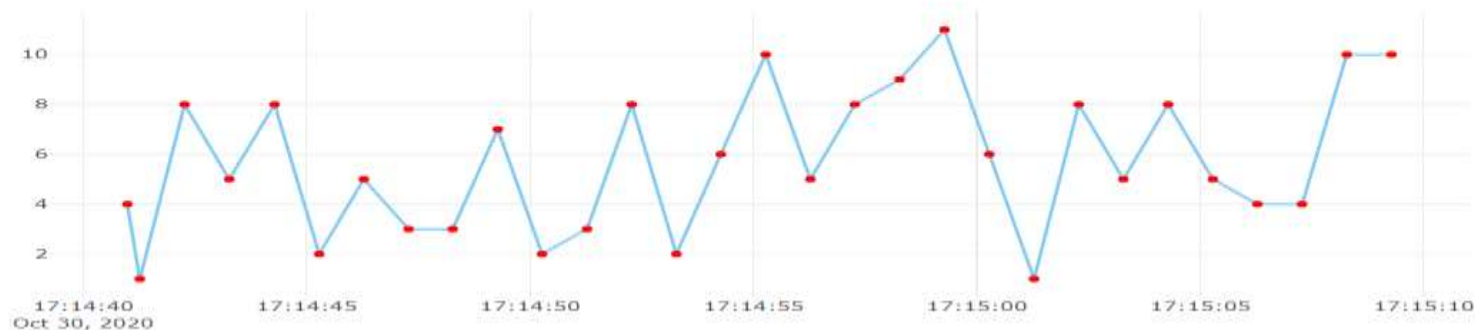
```
var cnt = 0;
var interval = setInterval(function () {
    var y = Math.round(Math.random() * 10) + 1;
    var time = new Date();
    timeArray = timeArray.concat(time);
    timeArray.splice(0, 1);
    newArray = newArray.concat(y);
    newArray.splice(0, 1);
    var update = {
        x: [timeArray],
        y: [newArray],
    };
    Plotly.update("graph", update);
    cnt++;
    if (cnt === 50) clearInterval(interval);
}, 1000);
```

[DIY] Streaming time series using 30 points update

Streaming using 30 points update



Streaming using 30 points update with timestamp



AAnn_DS_30timestamps.png 로 캡처 저장.

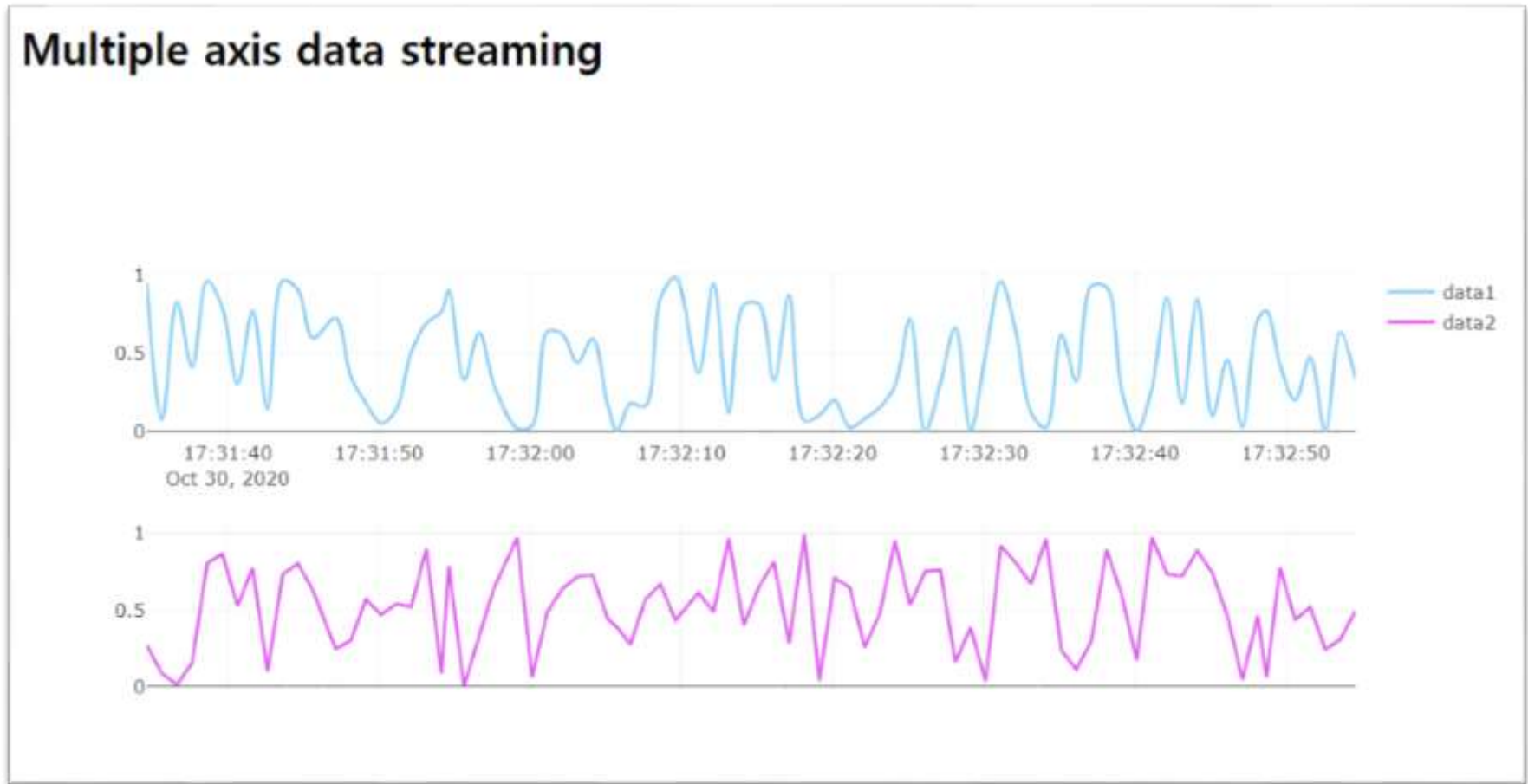


A5.4.5.4 plotly.js: Streaming data

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

```
var data = [  
  {  
    x: timeArray,  
    y: newArray,  
    mode: "lines+markers",  
    marker: { color: "#FF0000" },  
    line: { color: "#80CAF6" },  
  },  
];  
Plotly.newPlot("graph", data);
```

[5] Streaming data using multiple axis





A5.4.6.1 plotly.js: Streaming data

[5.1] Streaming data using multiple axis [DV_streaming05_multiple_axis.html](#)

```

<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],
  },
  yaxis: { domain: [0.6, 1] },

  xaxis2: {
    type: "date",
    anchor: "y2",
    domain: [0, 1],
    showticklabels: false, // 중요!
  },
  yaxis2: {
    anchor: "x2",
    domain: [0, 0.4],
  },
};

var data = [trace1, trace2];
Plotly.newPlot("graph", data, layout);

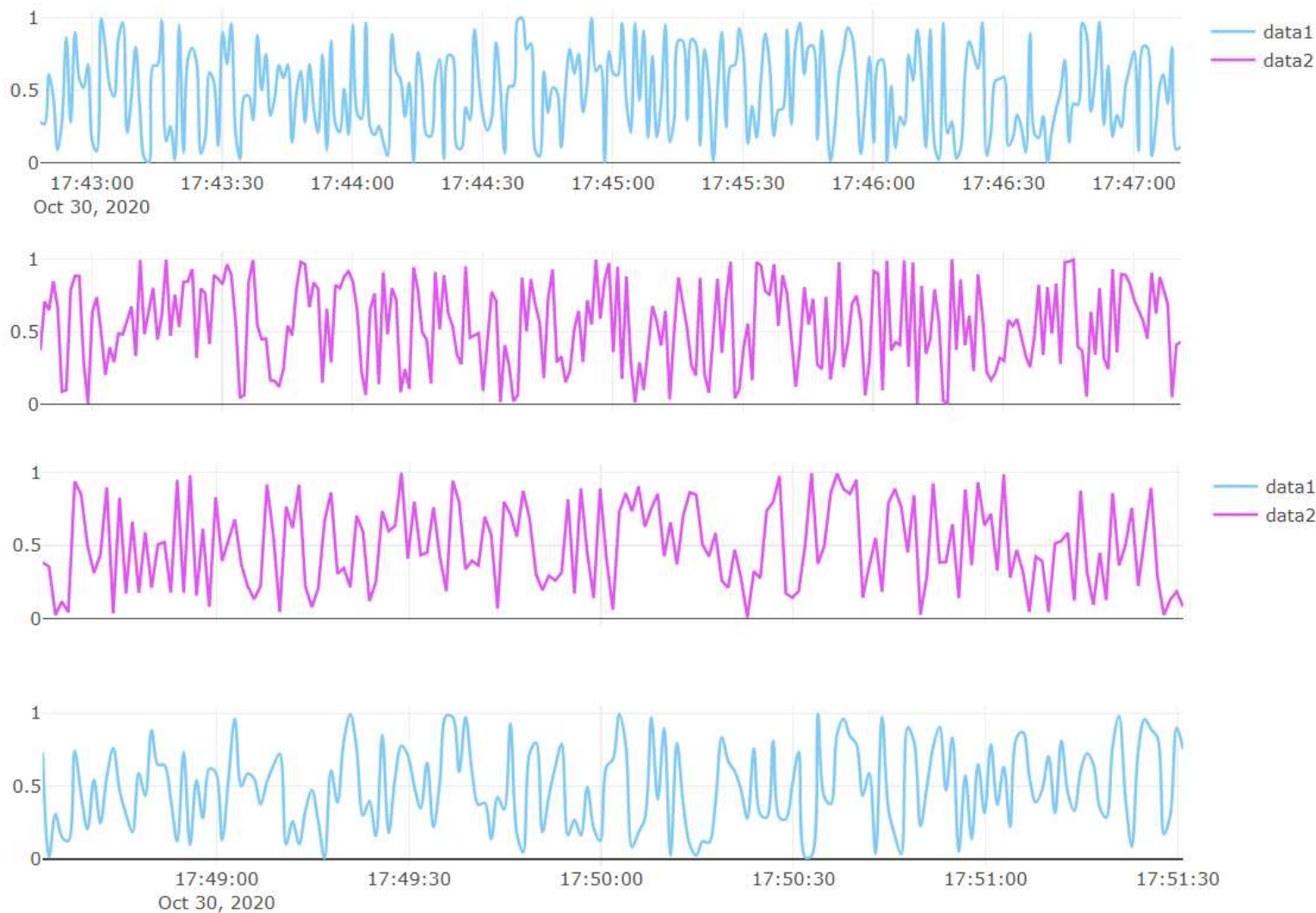
// streaming
var cnt = 0;
var interval = setInterval(function () {
  var time = new Date();
  var update = {
    x: [[time], [time]],
    y: [[rand()], [rand()]],
  };
  Plotly.extendTraces("graph", update, [0, 1]);
  // cnt++;
  if (cnt === 100) clearInterval(interval);
}, 1000);

```

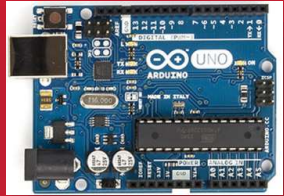



A5.4.6.2 plotly.js: Streaming data

[DIY] Streaming data using multiple axis → change axis

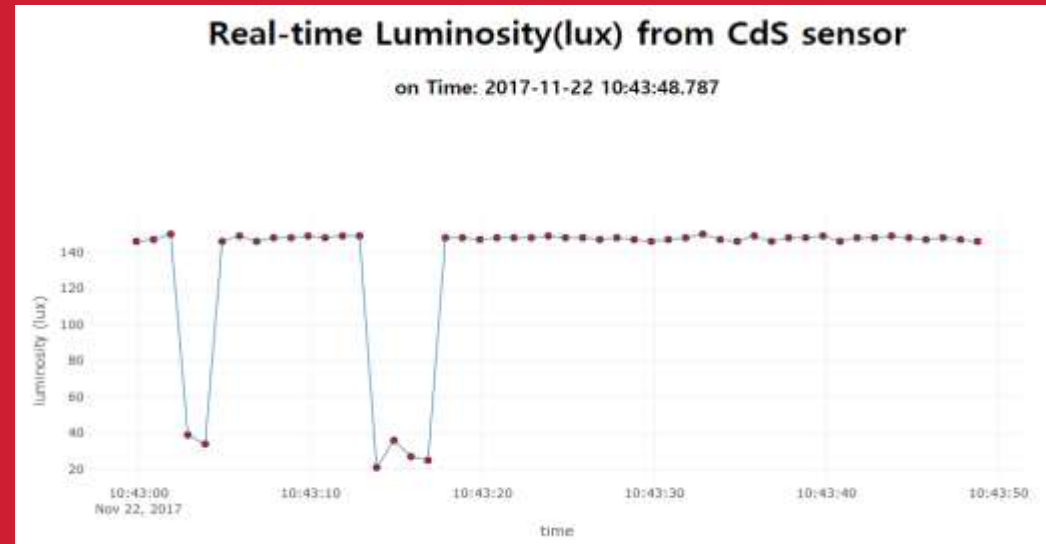


AAnn_DS_multiple_axis.png 로 캡처 저장.

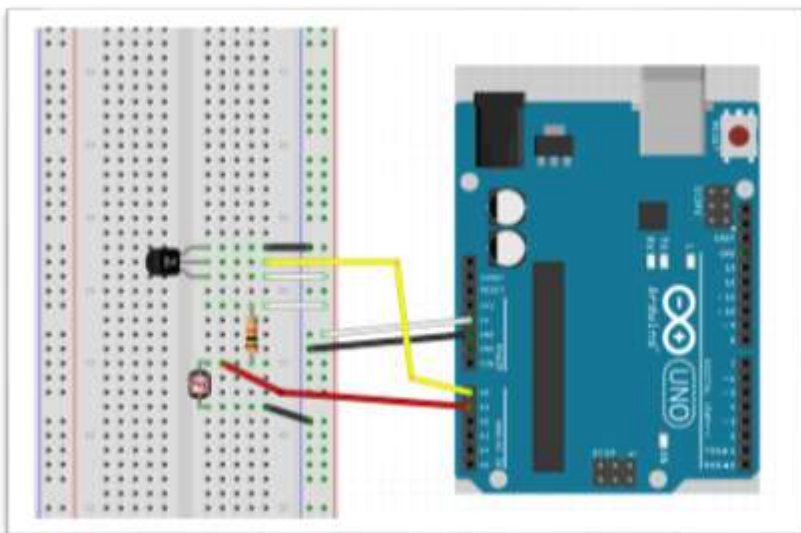


Arduino sensor data RT visualization using **plotly.js**

```
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
```



tmp36 + CdS circuit



AA00	2020-10-17	11:41:30.533	25.27,245
AA00	2020-10-17	11:41:31.535	25.27,243
AA00	2020-10-17	11:41:32.535	25.27,158
AA00	2020-10-17	11:41:33.534	24.29,40
AA00	2020-10-17	11:41:34.538	24.29,33
AA00	2020-10-17	11:41:35.537	24.78,86
AA00	2020-10-17	11:41:36.541	25.27,249
AA00	2020-10-17	11:41:37.540	25.76,245
AA00	2020-10-17	11:41:38.543	25.76,243
AA00	2020-10-17	11:41:39.543	25.27,245

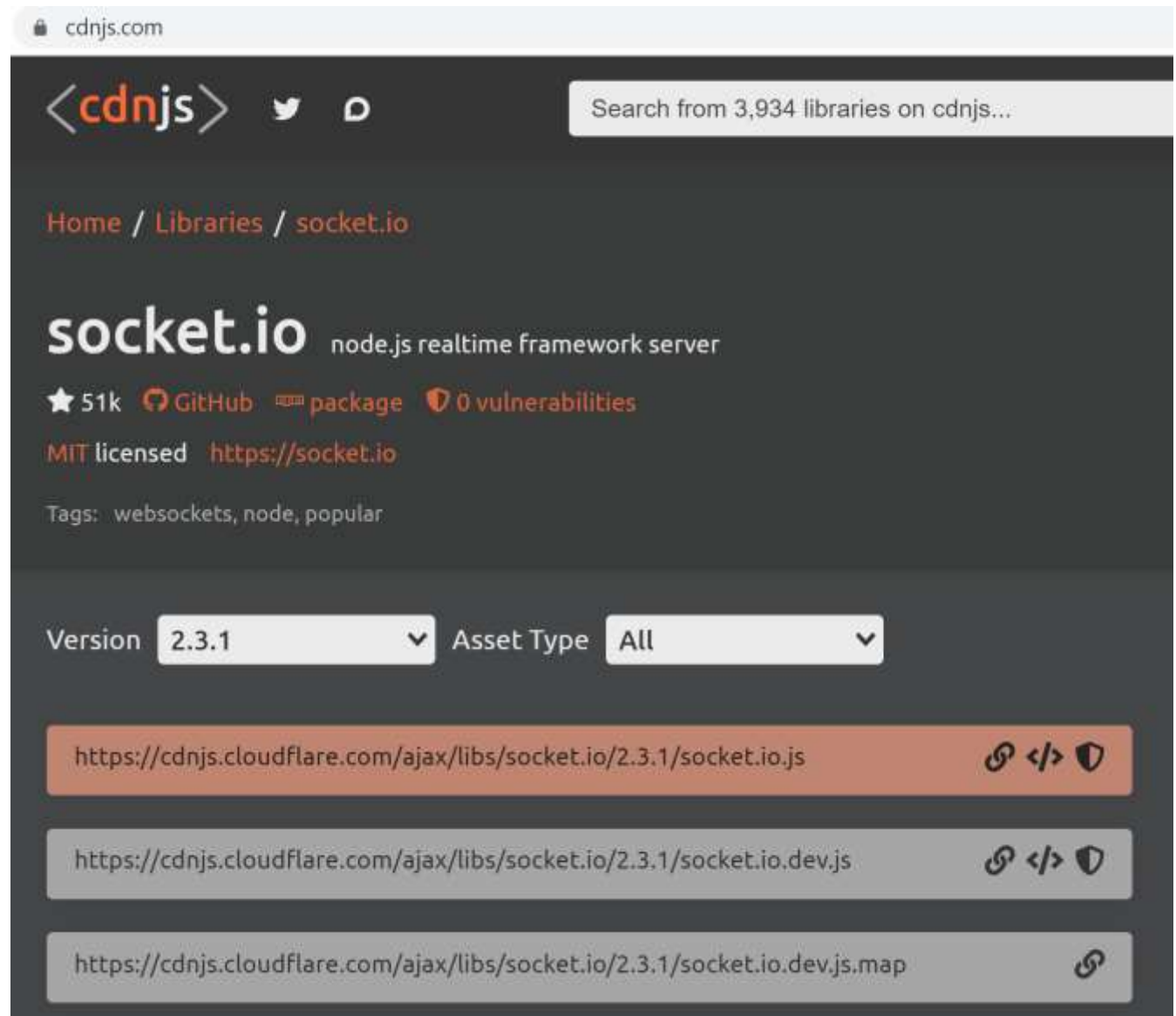
```
var readData = "";
var temp = "";
var lux = "";
var mdata = [];
var firstcommaidx = 0;

parser.on("data", (data) => {
  // call back when data is received
  readData = data.toString();
  firstcommaidx = readData.indexOf(",");
  if (firstcommaidx > 0) {
    temp = readData.substring(0, firstcommaidx);
    lux = readData.substring(firstcommaidx + 1);
    readData = "";

    dStr = getDateString();
    mdata[0] = dStr; //date
    mdata[1] = temp; //data
    mdata[2] = lux;
    console.log("AA00," + mdata);
    io.sockets.emit("message", mdata); // send data
  } else {
    console.log(readData);
  }
});
```




Arduino data on network socket

Google search
socket.io.js cdn



The screenshot shows the cdnjs.com website. The browser address bar displays 'cdnjs.com'. The website header includes the 'cdnjs' logo, social media icons for Twitter and GitHub, and a search bar with the text 'Search from 3,934 libraries on cdnjs...'. The main content area features a breadcrumb trail 'Home / Libraries / socket.io'. The library name 'socket.io' is prominently displayed, followed by the description 'node.js realtime framework server'. Below this, statistics are shown: '51k' stars, 'GitHub' link, 'package' link, and '0 vulnerabilities'. The license is listed as 'MIT licensed' with a link to 'https://socket.io'. Tags include 'websockets', 'node', and 'popular'. A filter section shows 'Version' set to '2.3.1' and 'Asset Type' set to 'All'. Three asset links are listed: 'https://cdnjs.cloudflare.com/ajax/libs/socket.io/2.3.1/socket.io.js', 'https://cdnjs.cloudflare.com/ajax/libs/socket.io/2.3.1/socket.io.dev.js', and 'https://cdnjs.cloudflare.com/ajax/libs/socket.io/2.3.1/socket.io.dev.js.map'. Each link has a copy icon, a code icon, and a shield icon.

cdnjs.com




<cdnjs>  

Search from 3,934 libraries on cdnjs...

Home / Libraries / socket.io

socket.io




node.js realtime framework server




★ 51k  GitHub  package  0 vulnerabilities


MIT licensed <https://socket.io>

Tags: websockets, node, popular

Version Asset Type

<https://cdnjs.cloudflare.com/ajax/libs/socket.io/2.3.1/socket.io.js>   

<https://cdnjs.cloudflare.com/ajax/libs/socket.io/2.3.1/socket.io.dev.js>   

<https://cdnjs.cloudflare.com/ajax/libs/socket.io/2.3.1/socket.io.dev.js.map> 

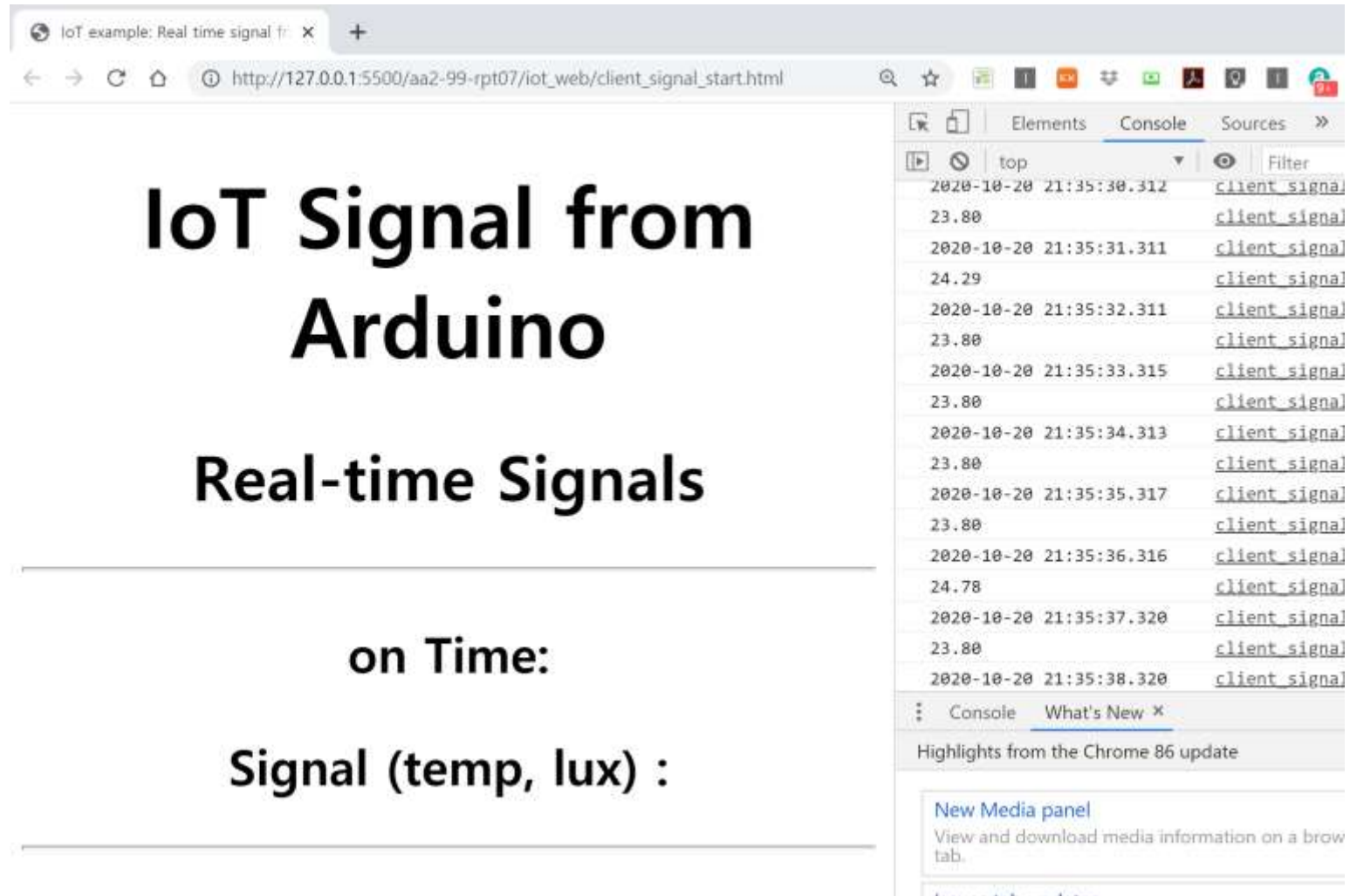
Arduino data on network socket

client_signal_start.html

```
1 <!DOCTYPE html>
2 <head>
3   <meta charset="utf-8">
4   <title>IoT example: Real time signal from Arduino</title>
5
6   <script type="text/javascript" src="https://cdnjs.cloudflare.com/ajax/libs/socket.io/2.3.1/socket.io.js"></script>
7   <!-- <script type="text/javascript" src="https://cdnjs.cloudflare.com/ajax/libs/socket.io/1.3.6/socket.io.js"></scr
8   <style>body {padding:0;margin:30;background: #fff}</style>
9 </head>
10
11 <body> <!-- style="width:100%;height:100%"> -->
12 |
13 <h1 align="center"> IoT Signal from Arduino </h1>
14
15 <h2 align="center"> Real-time Signals </h2>
16
17 <hr>
18
19 <h3 align="center"> on Time: <span id="time"> </span> </h3>
20
21 <h3 align="center"> Signal (temp, lux) : <span id="data"> </span> </h3>
22
```

Google search : [socket.io.js cdn](#)

Arduino data on network socket



The screenshot shows a web browser window with the address bar displaying `http://127.0.0.1:5500/aa2-99-rpt07/iot_web/client_signal_start.html`. The main content area displays the text "IoT Signal from Arduino" and "Real-time Signals" in a large, bold, black font. Below this, the text "on Time:" and "Signal (temp, lux) :" is shown in a smaller, bold, black font. To the right of the main content, the Chrome DevTools Console is open, showing a list of log entries. Each entry consists of a timestamp (e.g., "2020-10-20 21:35:30.312") followed by the text "client signal". The console also shows a "What's New" section with a link to "New Media panel".

IoT Signal from Arduino

Real-time Signals

on Time:

Signal (temp, lux) :

2020-10-20 21:35:30.312 client signal

23.80 client signal

2020-10-20 21:35:31.311 client signal

24.29 client signal

2020-10-20 21:35:32.311 client signal

23.80 client signal

2020-10-20 21:35:33.315 client signal

23.80 client signal

2020-10-20 21:35:34.313 client signal

23.80 client signal

2020-10-20 21:35:35.317 client signal

23.80 client signal

2020-10-20 21:35:36.316 client signal

24.78 client signal

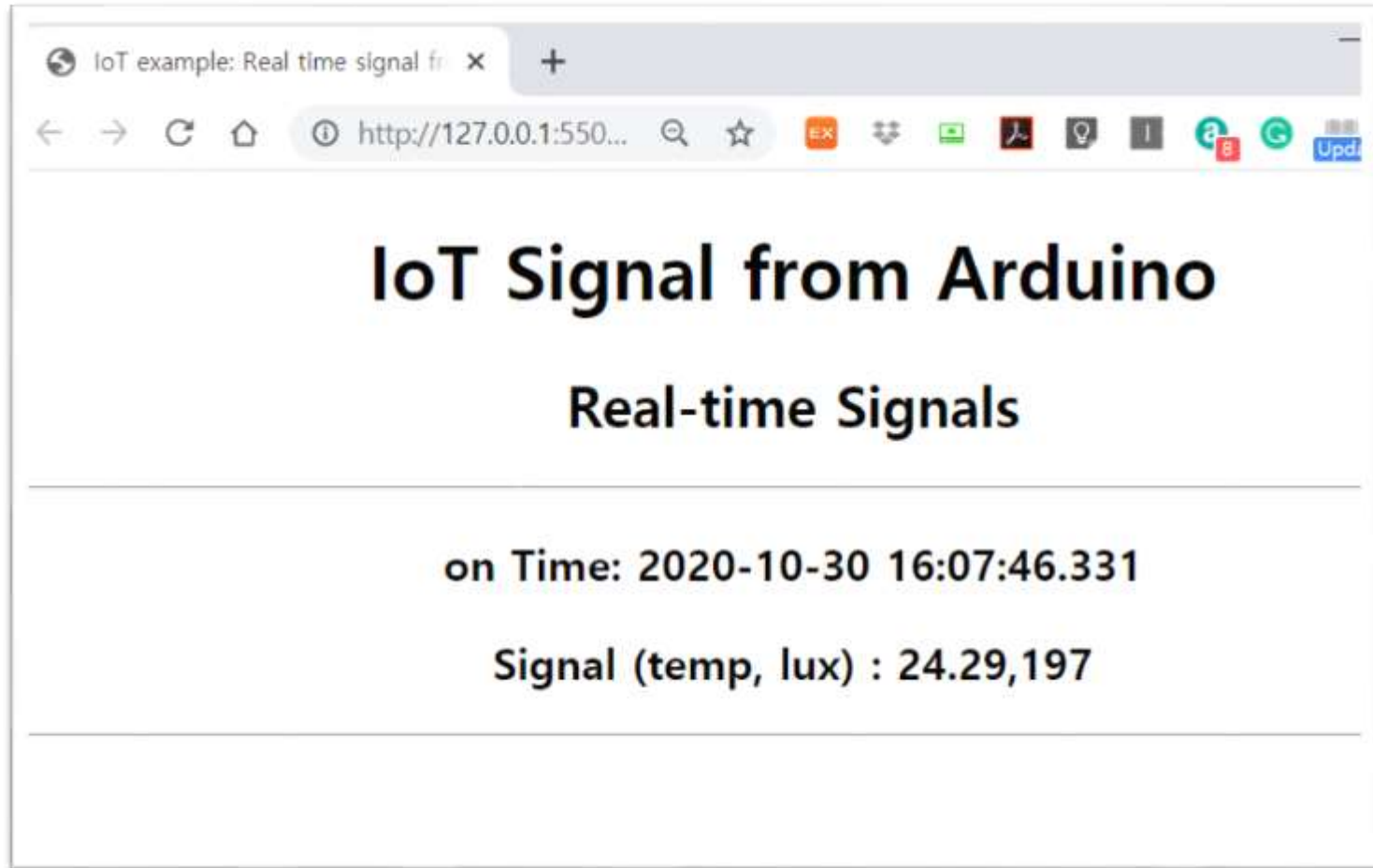
2020-10-20 21:35:37.320 client signal

23.80 client signal

2020-10-20 21:35:38.320 client signal

Real-time **console** showing a signal from Arduino
in **Chrome browser** – F12

Arduino data on network socket

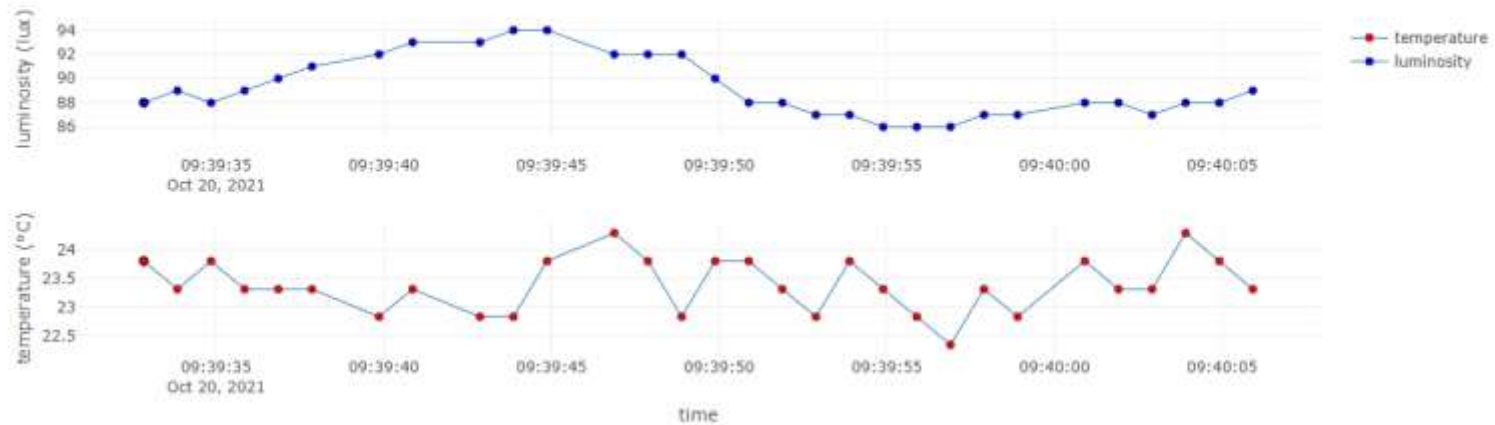


**Real-time monitoring of a signal from Arduino
tmp36 + CdS circuit**

Real-time Temperature($^{\circ}\text{C}$) and Luminosity(lux) from sensors



on Time: 2021-10-20 09:40:05.918

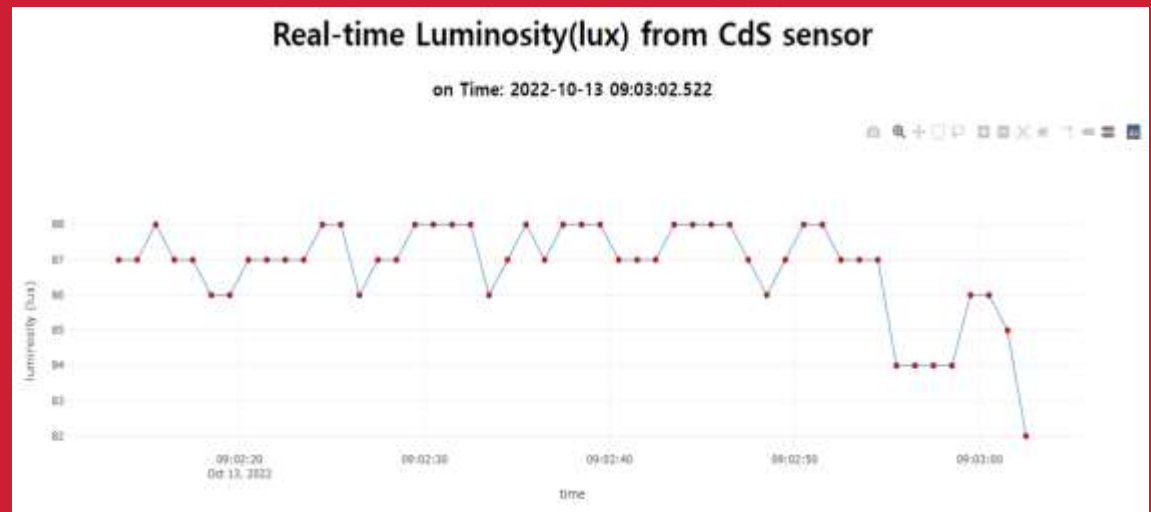
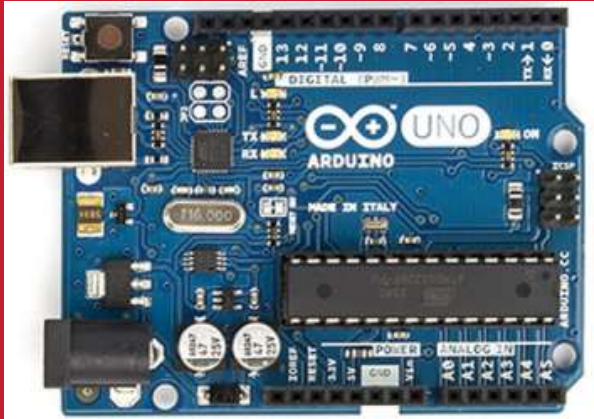




Single sensor: CdS

CdS (LDR)

Node project





A4.2.1 Luminosity sensor [Photocell LDR]

1. Make cds node project

➤ md cds

➤ cd cds

2. Go to cds subfolder

➤ npm init

➤ npm install --save [serialport@9.2.4](#)

➤ npm install --save [socket.io@2.4.1](#)

- npm Error 발생하면,

➤ npm update

Package.json

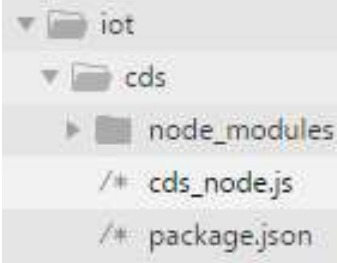
✓ aann > aann-rpt08 > Node > cds > package.json > ...

```
1  {
2    "name": "cds",
3    "version": "1.0.0",
4    "description": "cds-node project",
5    "main": "cds_node.js",
6    "scripts": {
7      "test": "echo \"Error: no test specified\" && exit 1"
8    },
9    "keywords": [
10     "cds",
11     "node",
12     "arduino"
13   ],
14   "author": "aa00",
15   "license": "MIT",
16   "dependencies": {
17     "serialport": "^9.2.4",
18     "socket.io": "^2.4.1"
19   }
20 }
```

npm install



A4.2.2 Luminosity sensor [Photocell LDR]



cds_node.js

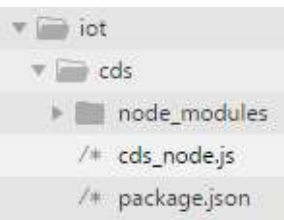
```
var dStr = "";
var tdata = []; // Array

parser.on("data", (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); //
});
```

시간, 온도

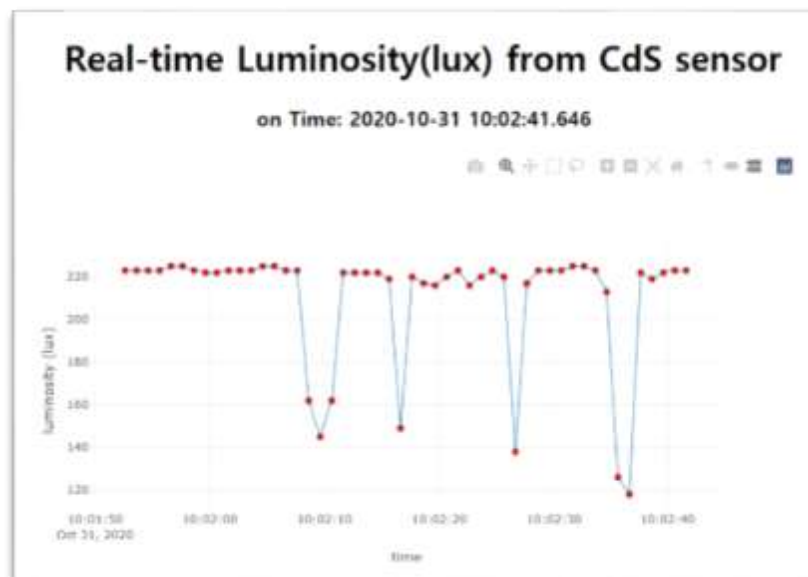


A4.2.3 cds_node project (실행 결과)



D:\Portable\vscode-portable\data\aa2-00\aa2-99-rpt08\wk11_src_start\Node\cds_node cds_node
serial port open

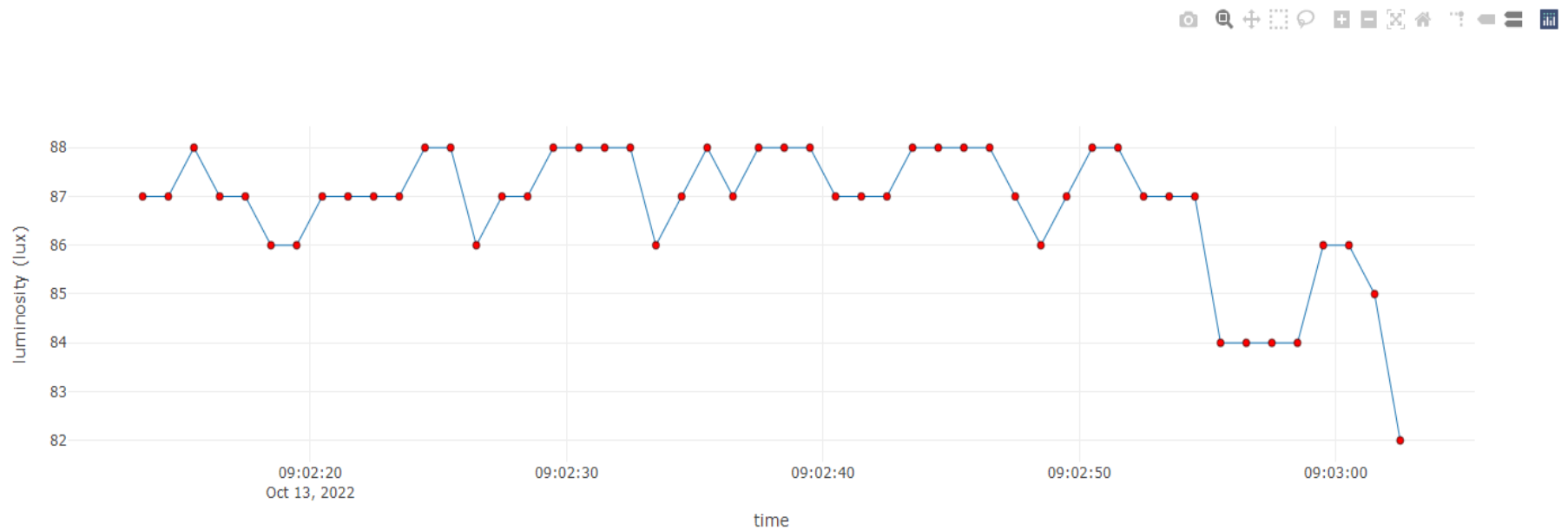
```
AA00,2020-10-31 09:40:24.912,220  
AA00,2020-10-31 09:40:25.910,220  
AA00,2020-10-31 09:40:26.914,220  
AA00,2020-10-31 09:40:27.913,220  
AA00,2020-10-31 09:40:28.912,222  
AA00,2020-10-31 09:40:29.912,220  
AA00,2020-10-31 09:40:30.915,220  
AA00,2020-10-31 09:40:31.914,91  
AA00,2020-10-31 09:40:32.914,217  
AA00,2020-10-31 09:40:33.917,220
```



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

Real-time Luminosity(lux) from CdS sensor

on Time: 2022-10-13 09:03:02.522





A5.5.1 RT sensor-data streaming in Arduino

[1] Client html : client_cds.html (using [socket.io.js](#) & [plotly.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/2.3.1/socket.io.js"></script>
  <style>body{padding:0;margin:30;background: #fff}</style>
</head>
```



A5.5.2 RT sensor-data streaming in Arduino

[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;
```



A5.5.3 RT sensor-data streaming in Arduino

[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();
  });
});
```



A5.5.4 RT sensor-data streaming in Arduino

[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]
  }
};
```

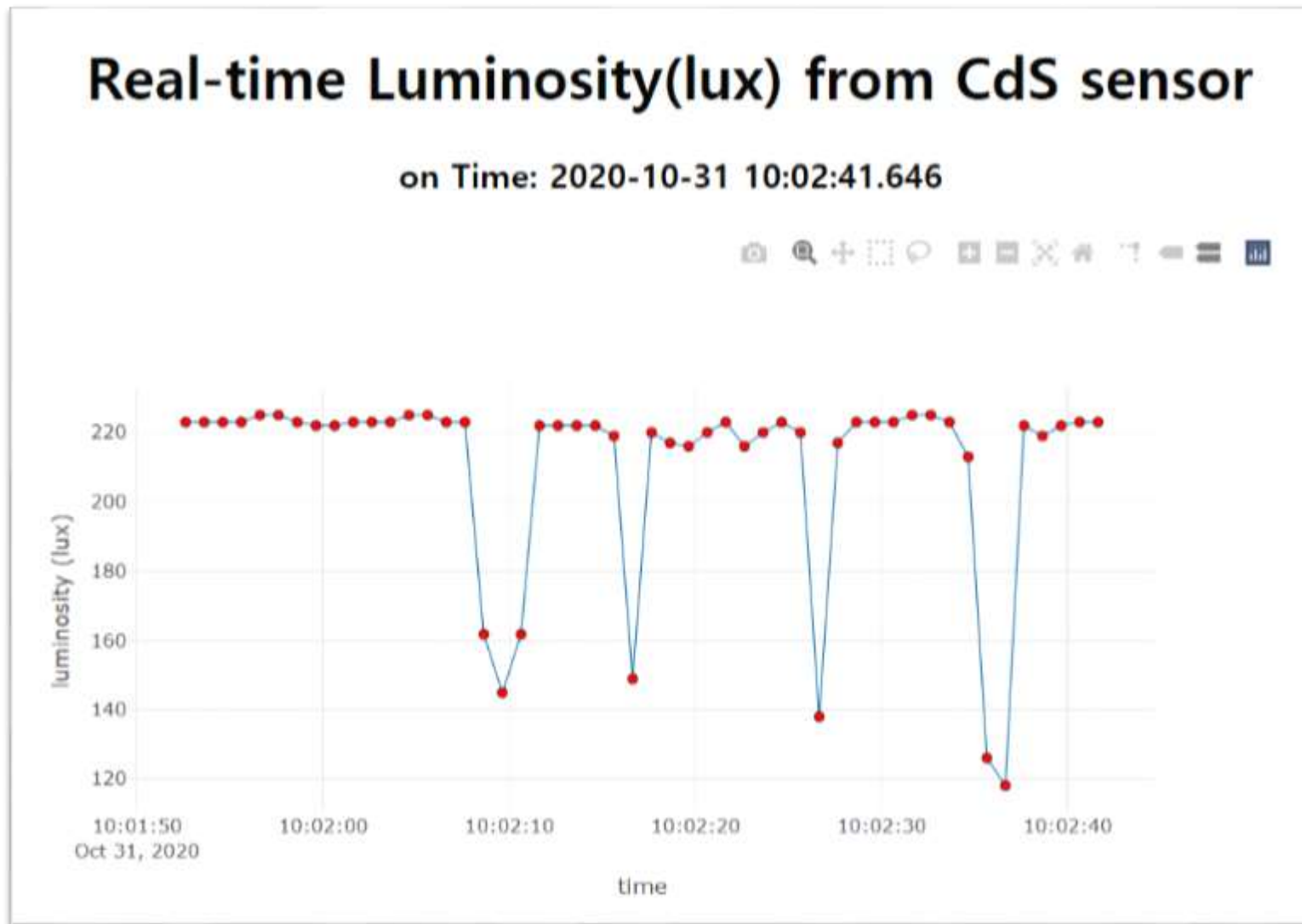
domain: [0,1] → x 또는 y 축을 100% 사용

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(dtdata[0]);  
  
    xTrack.shift();  
    xTrack.push(dtdata[1]); //  
  
    Plotly.redraw(streamPlot);  
}  
*/
```

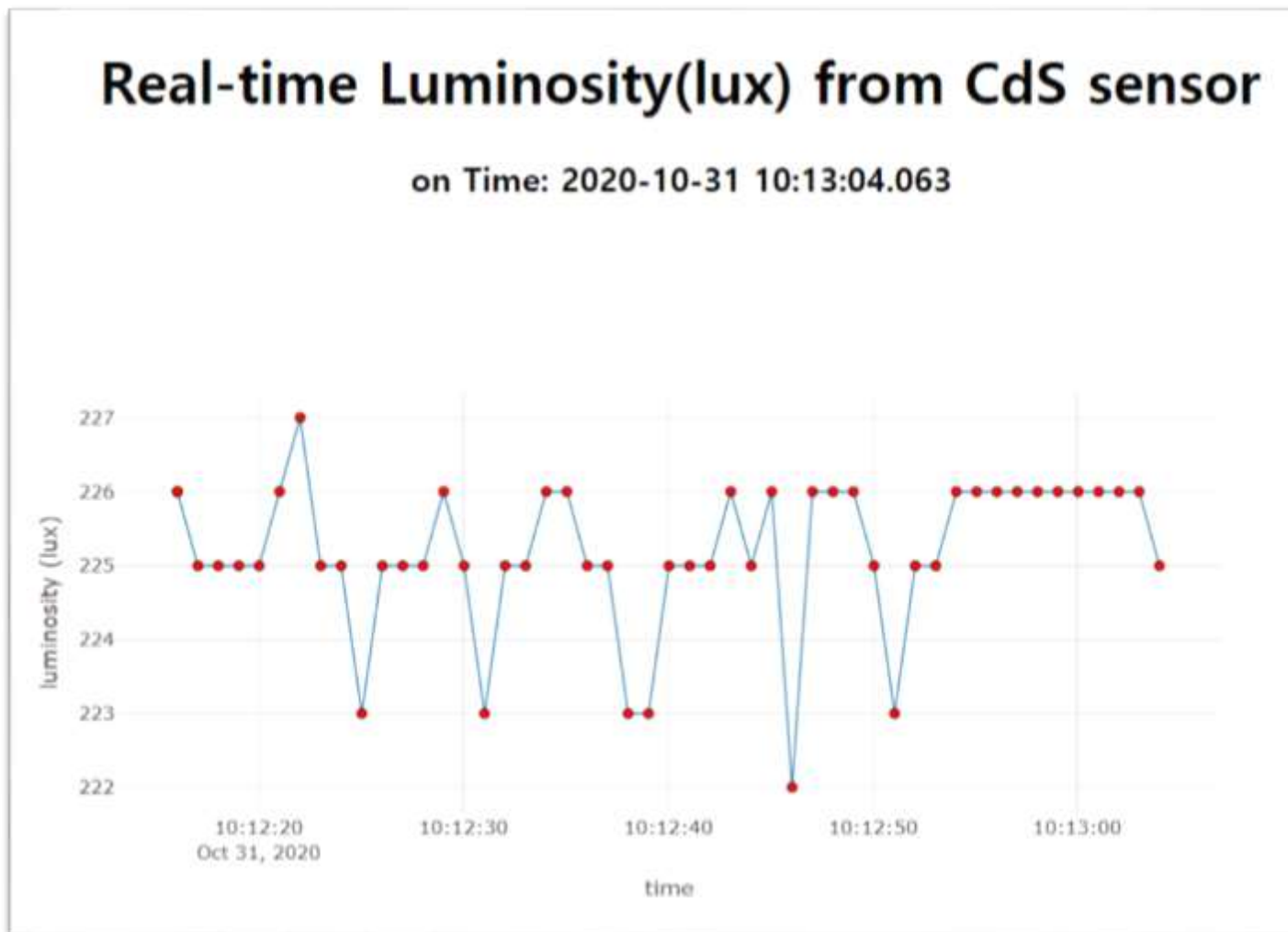
nextPt() 주석 처리

```
socket.on('connect', function () {  
    socket.on('message', function (msg) {  
        // initial plot  
        if(msg[0]!='' && initFlag){  
            dtdata[0]=msg[0];  
            dtdata[1]=parseInt(msg[1]); // lux  
            init(); // start streaming  
            initFlag=false;  
        }  
        console.log(msg[0]);  
        console.log(parseInt(msg[1])); // Convert  
        dtdata[0]=msg[0];  
        dtdata[1] = parseInt(msg[1]);  
  
        // when new data is coming, keep on stream  
        ctime.innerHTML = dtdata[0];  
        //nextPt();  
        tArray = tArray.concat(dtdata[0]); // time  
        tArray.splice(0,1);  
        xTrack = xTrack.concat(dtdata[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

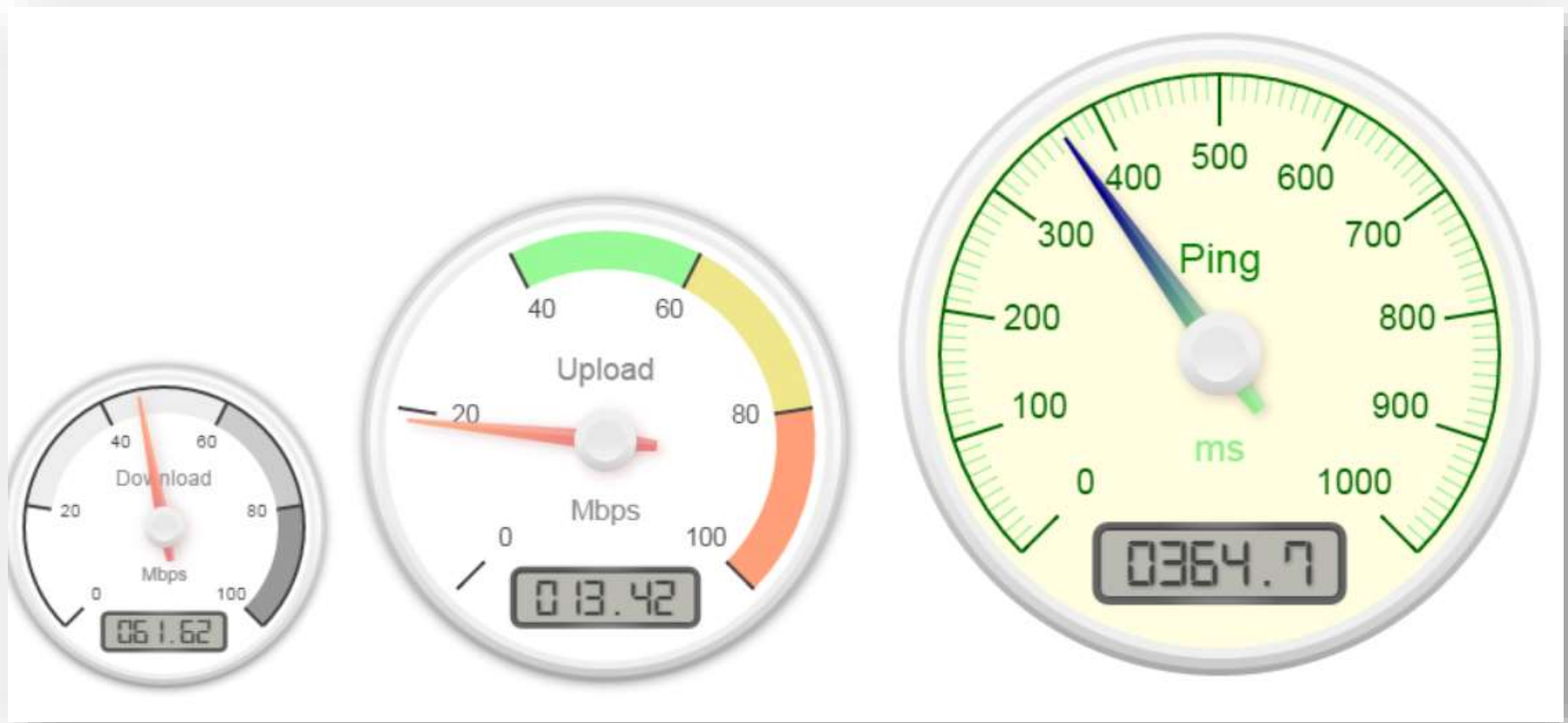
[7.2] Client html : **client_cds2.html** (using plotly streaming without nextPt())





Canvas Gauge

[1] Canvas gauge javascript library : example



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



Canvas Gauge

[2] Canvas gauge javascript library : [gauge.js](https://github.com/Mikhus/canv-gauge)

Mikhus / **canv-gauge** Watch 29 Star

HTML5 Canvas Gauge

66 commits 1 branch 0 releases 6 contributors

Branch: master canv-gauge / +

Mikhus Fixed issue #26 Latest commit c41b7b2 on 23 Jul 2014

fonts	Merged Issue-18 from rblackburn	2 years ago
README	Fixed issue #26	a year ago
build.bat	Added Google Closure Compiler	3 years ago
build.sh	Merge branch 'master' of https://github.com/rblackburn/canv-gauge in...	3 years ago
compiler.jar	Added Google Closure Compiler	3 years ago
example-html-gauge.html	Fixed #4 - Cannot handle negative values	3 years ago
example-resize.html	Switch to minified version	3 years ago
example.html	Switch to minified version	3 years ago
gauge.js	Fixes #27 rgb[a] colour format in html	2 years ago
gauge.min.js	Fixes #27 rgb[a] colour format in html	2 years ago



A5.5.8.1 RT sensor-data streaming in Arduino

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

```
<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/2.3.1/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 Luminosity(lux) from CdS sensor with Gauge</h1>
  <!-- Lux gauge -->
  <div align="center">
    <canvas id='gauge'></canvas>
  </div>
```



A5.5.8.2 RT sensor-data streaming in Arduino

[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]); // 1
    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();

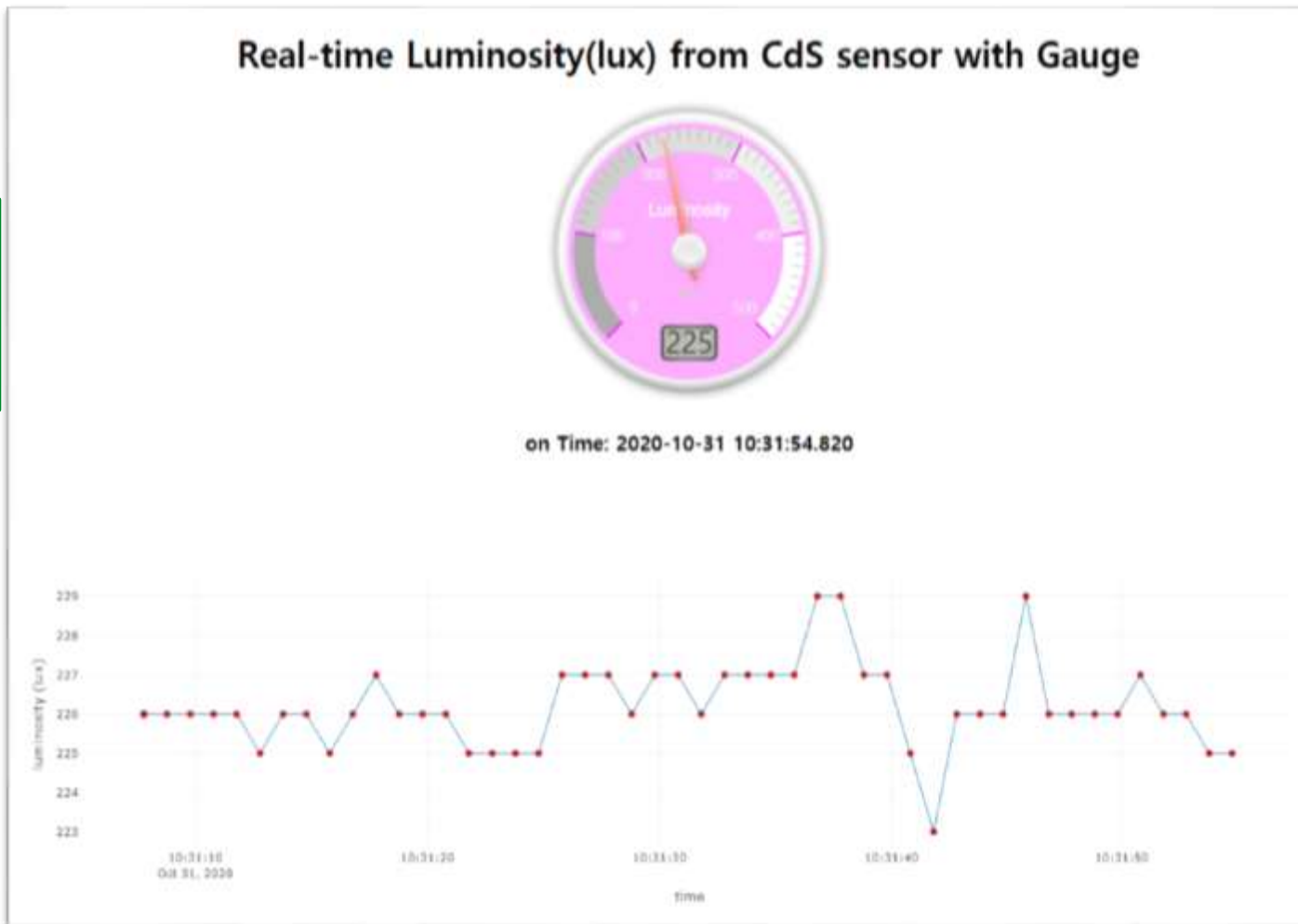
```



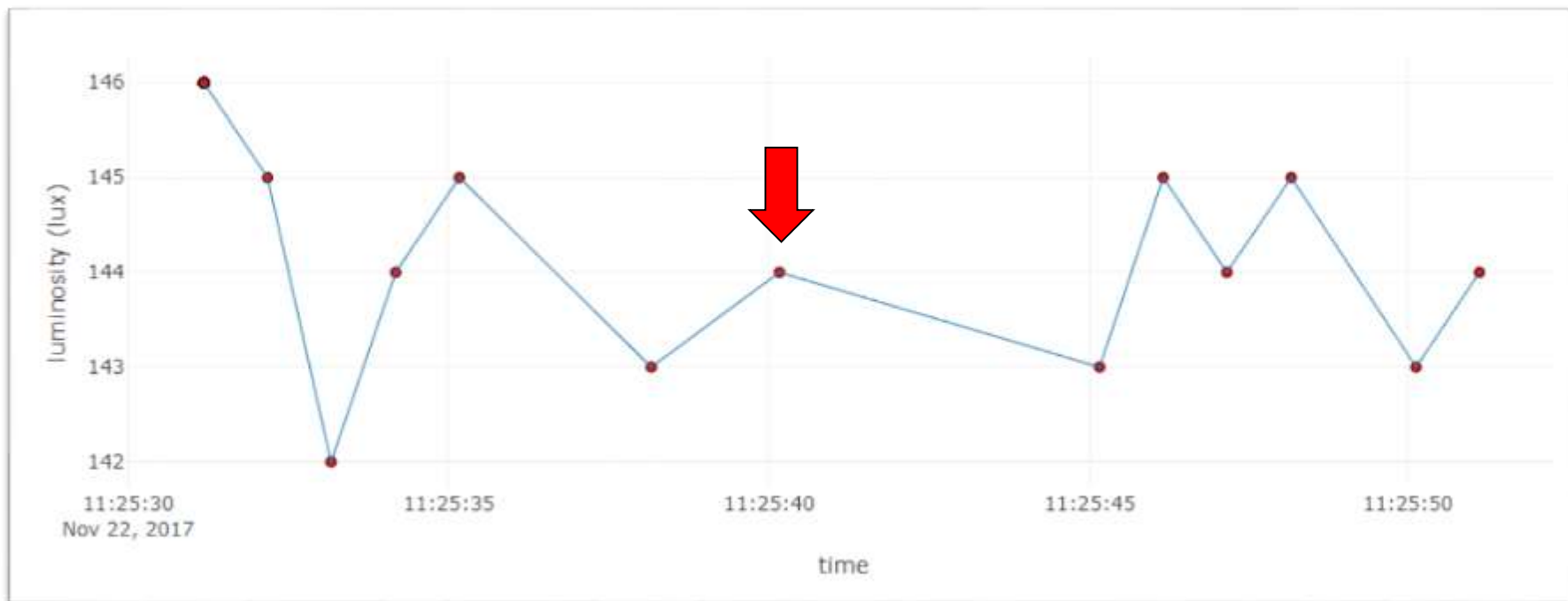
A5.5.8.3 RT sensor-data streaming in Arduino

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

변경된 디자인으로 된
그래프를 캡처하여
AAnn_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.

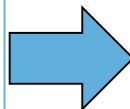
밝기 값 변화의 문턱값을 설정해서 이상 감지 기능 구현



A5.5.9.2 RT sensor-data streaming in Arduino

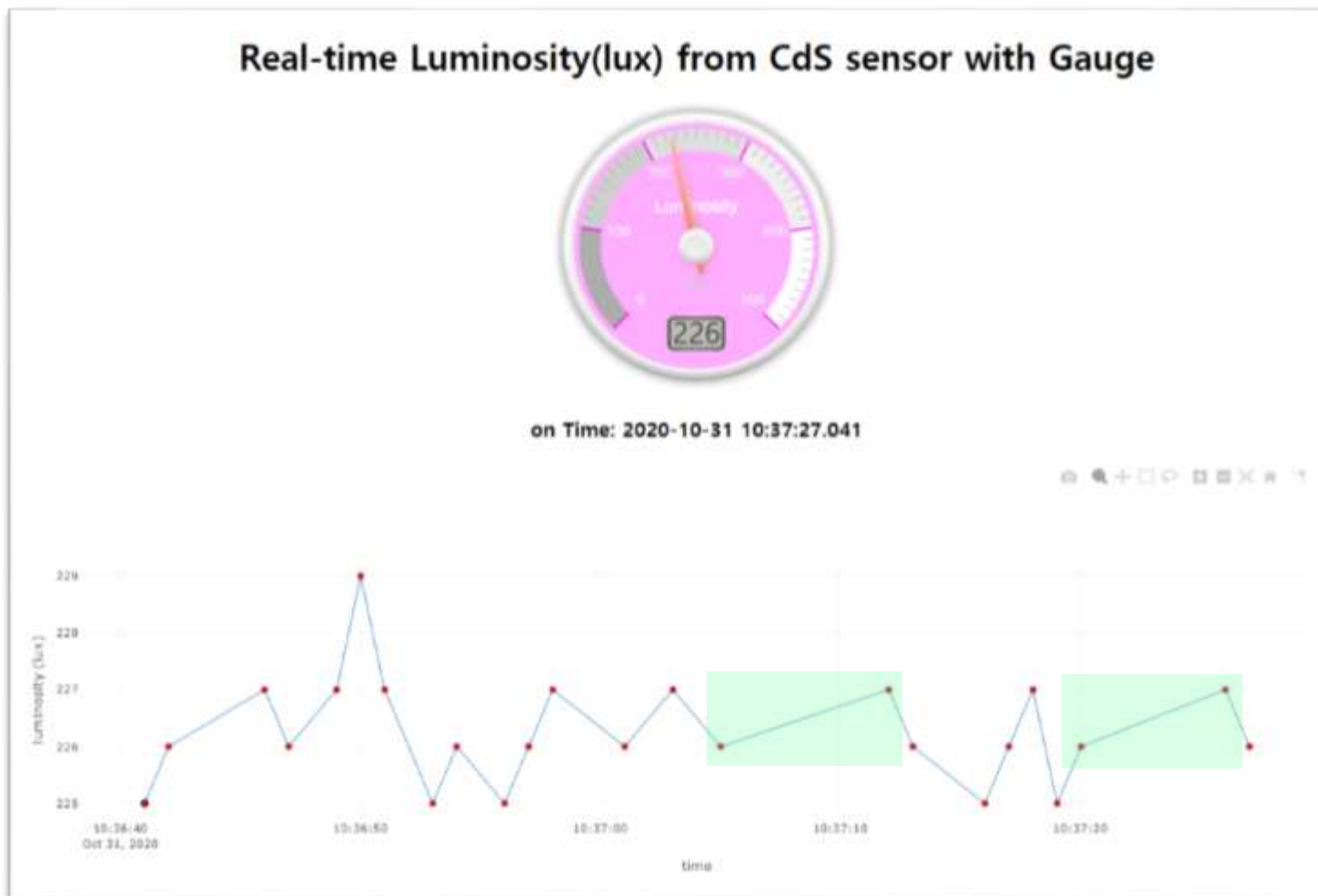
[DIY. hint] Client html : **client_cds_change.html** (detecting change)

```
// when new data is coming,  
// keep on streaming data  
ctime.innerHTML = dtdata[0];  
gauge_lux.setValue(dtdata[1]); // lux gauge  
//nextPt();  
tArray = tArray.concat(dtdata[0]); // time  
tArray.splice(0,1);  
xTrack = xTrack.concat(dtdata[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 (dtdata[1] != preX) { // any change?  
  preX = dtdata[1];  
  
  ctime.innerHTML = dtdata[0];  
  gauge_lux.setValue(dtdata[1]); // lux gauge  
  //nextPt();  
  tArray = tArray.concat(dtdata[0]); // time  
  tArray.splice(0,1);  
  xTrack = xTrack.concat(dtdata[1]); // lux  
  xTrack.splice(0,1);  
  
  var update = {  
    x: [tArray],  
    y: [xTrack]  
  }  
  
  Plotly.update(streamPlot, update);  
}
```

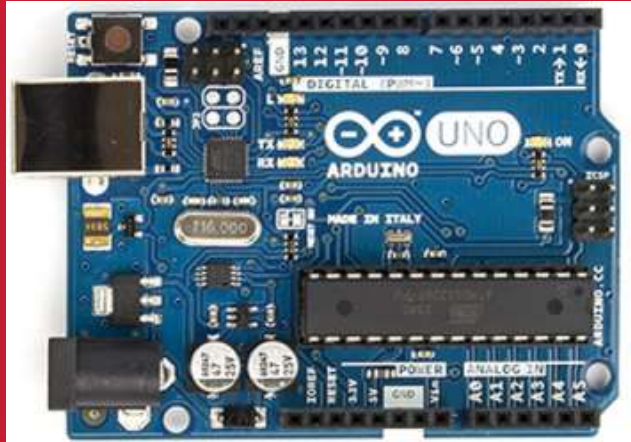
[DIY] Client html : **client_cds_change.html** (detecting change)



측정되는 주변 광의 밝기가 일정 시간 유지되다가 변하는
그래프를 캡처하여 **AAnn_cds_change.png** 로 저장



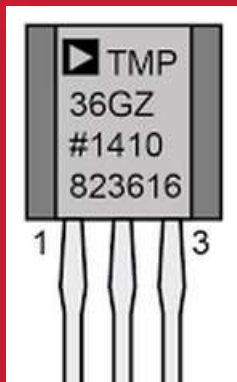
Multiple sensors



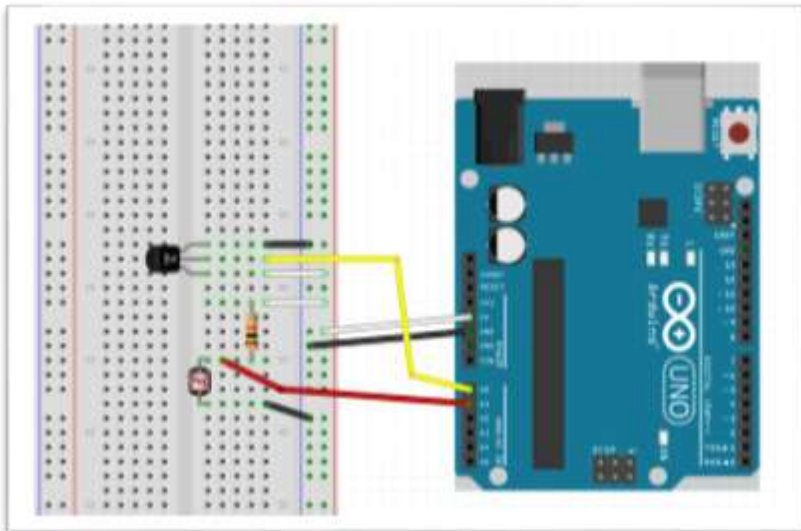
CdS + TMP36

+ plotly.js

Node project



tmp36 + CdS circuit



AA00	2020-10-17 11:41:30.533	25.27,245
AA00	2020-10-17 11:41:31.535	25.27,243
AA00	2020-10-17 11:41:32.535	25.27,158
AA00	2020-10-17 11:41:33.534	24.29,40
AA00	2020-10-17 11:41:34.538	24.29,33
AA00	2020-10-17 11:41:35.537	24.78,86
AA00	2020-10-17 11:41:36.541	25.27,249
AA00	2020-10-17 11:41:37.540	25.76,245
AA00	2020-10-17 11:41:38.543	25.76,243
AA00	2020-10-17 11:41:39.543	25.27,245

```
var readData = "";
var temp = "";
var lux = "";
var mdata = [];
var firstcommaidx = 0;

parser.on("data", (data) => {
  // call back when data is received
  readData = data.toString();
  firstcommaidx = readData.indexOf(",");
  if (firstcommaidx > 0) {
    temp = readData.substring(0, firstcommaidx);
    lux = readData.substring(firstcommaidx + 1);
    readData = "";

    dStr = getDateString();
    mdata[0] = dStr; //date
    mdata[1] = temp; //data
    mdata[2] = lux;
    console.log("AA00," + mdata);
    io.sockets.emit("message", mdata); // send data
  } else {
    console.log(readData);
  }
});
```

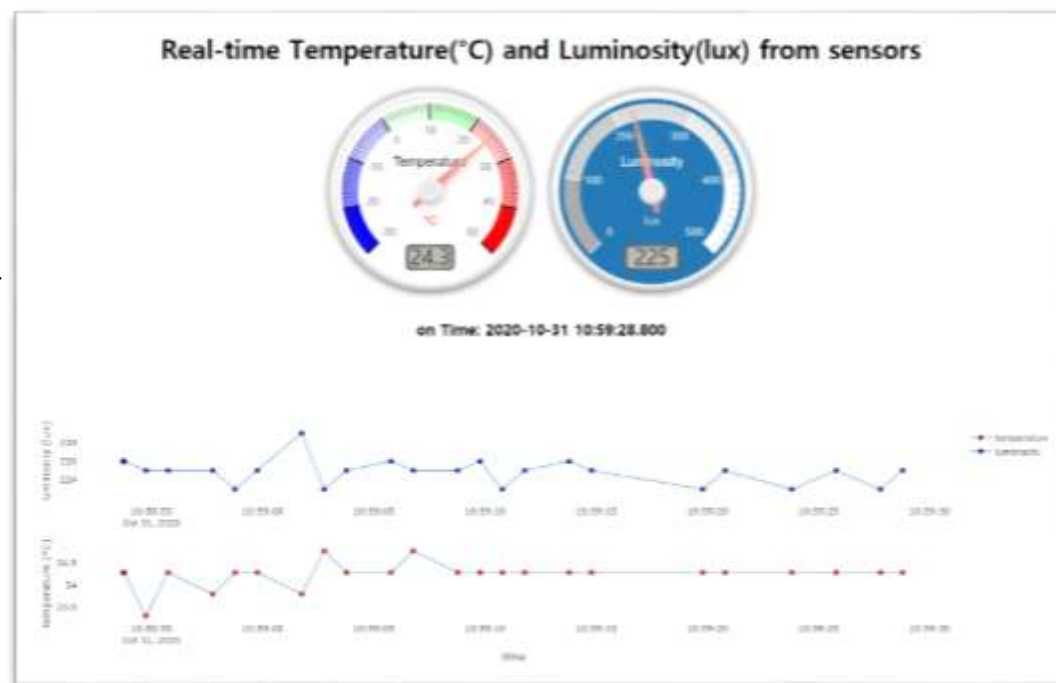
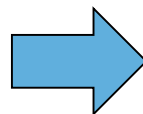
시간, 온도, 조도



A5.6.1 cds_tmp36_node project (실행 결과)

D:\Portable\vscode-portable\data\aa2-00\aa2-99-rpt08\wk11_src_start\Node\cds_tmp36_node cds_tmp36_node
serial port open

AA00,2020-10-31 10:51:17.221,23.80,226
AA00,2020-10-31 10:51:18.220,24.29,226
AA00,2020-10-31 10:51:19.223,24.29,225
AA00,2020-10-31 10:51:20.223,24.29,225
AA00,2020-10-31 10:51:21.226,24.78,225
AA00,2020-10-31 10:51:22.226,25.27,225
AA00,2020-10-31 10:51:23.230,24.29,208
AA00,2020-10-31 10:51:24.229,25.27,213
AA00,2020-10-31 10:51:25.228,24.78,219
AA00,2020-10-31 10:51:26.232,24.29,193
AA00,2020-10-31 10:51:27.231,24.29,151
AA00,2020-10-31 10:51:28.234,24.29,225
AA00,2020-10-31 10:51:29.234,24.29,225
AA00,2020-10-31 10:51:30.237,24.29,225
AA00,2020-10-31 10:51:31.237,24.29,226
AA00,2020-10-31 10:51:32.236,24.29,226
AA00,2020-10-31 10:51:33.240,24.29,227
AA00,2020-10-31 10:51:34.239,24.29,223
AA00,2020-10-31 10:51:35.243,24.29,223
AA00,2020-10-31 10:51:36.242,24.29,225
AA00,2020-10-31 10:51:37.245,24.29,226
AA00,2020-10-31 10:51:38.245,24.29,226



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/2.3.1/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>
```



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 (dtdda[1] != preX || dtdda[2] != preY) { // any change?
    preX = dtdda[1];
    preY = dtdda[2];

    ctime.innerHTML = dtdda[0];
    gauge_temp.setValue(dtdda[1]) // temp gauge
    gauge_lux.setValue(dtdda[2]); // lux gauge
    //nextPt();
    tArray = tArray.concat(dtdda[0]); // time
    tArray.splice(0,1);
    xTrack = xTrack.concat(dtdda[1]) // temp
    xTrack.splice(0, 1) // remove the oldest data
    yTrack = yTrack.concat(dtdda[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(dtdata[0]); // date  
    xTrack.push(dtdata[1]); // sensor 1 (temp)  
    yTrack.push(dtdata[2]); // sensor 2 (lux)  
  }  
  
  Plotly.newPlot(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();
```

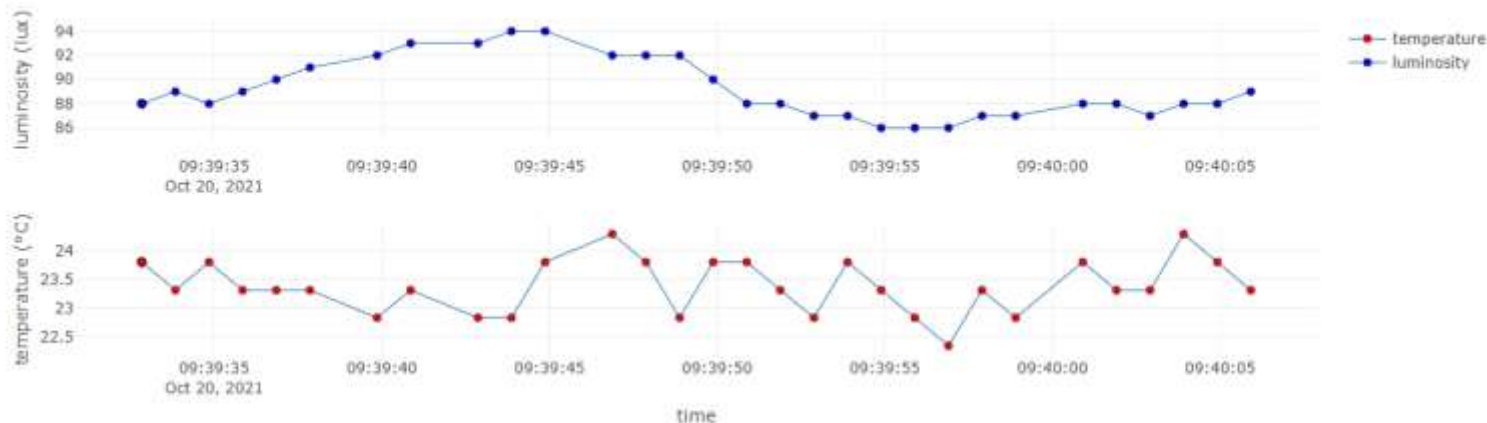
```
var gauge_lux = new Gauge({
  renderTo    : 'gauge2',
  width       : 300,
  height      : 300,
  glow        : true,
  units       : 'lux',
  valueFormat : { int : 3, dec : 0 },
  title       : "Luminosity",
  minValue    : 0,
  maxValue    : 500, // new
  majorTicks  : [ '0', '100', '200', '300',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

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

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



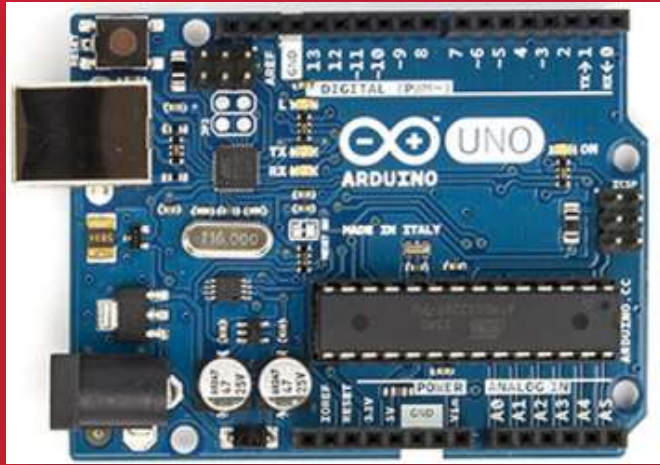
on Time: 2021-10-20 09:40:05.918



Gauge 디자인 변경한 후에, [AAnn_DS_cds_tmp36.png](#) 로 저장



CdS + DHT22

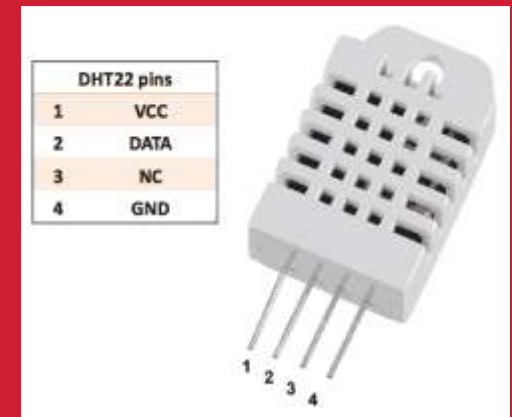


+ **plotly.js**

Node project

Multi-sensors

DHT22 + CdS



DHT22 pins	
1	VCC
2	DATA
3	NC
4	GND



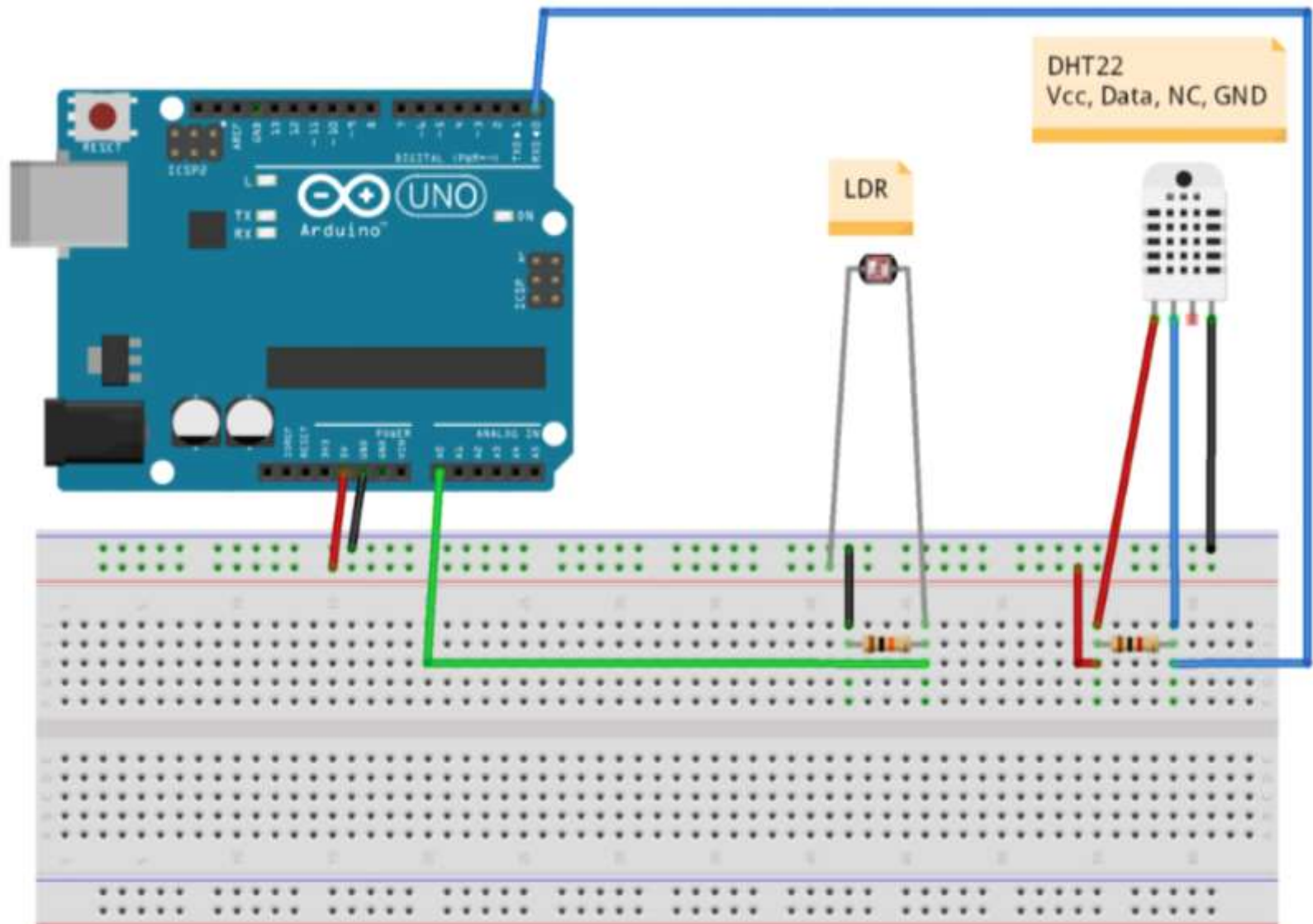
그림 8-7 DHT22 pin 구조

- 3 ~ 5V power and I/O
- 2.5mA max current
- [0-100%] humidity readings with 2-5% accuracy
- [-40 to 80°C] temperature readings $\pm 0.5^{\circ}\text{C}$ accuracy
- 0.5 Hz sampling rate

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

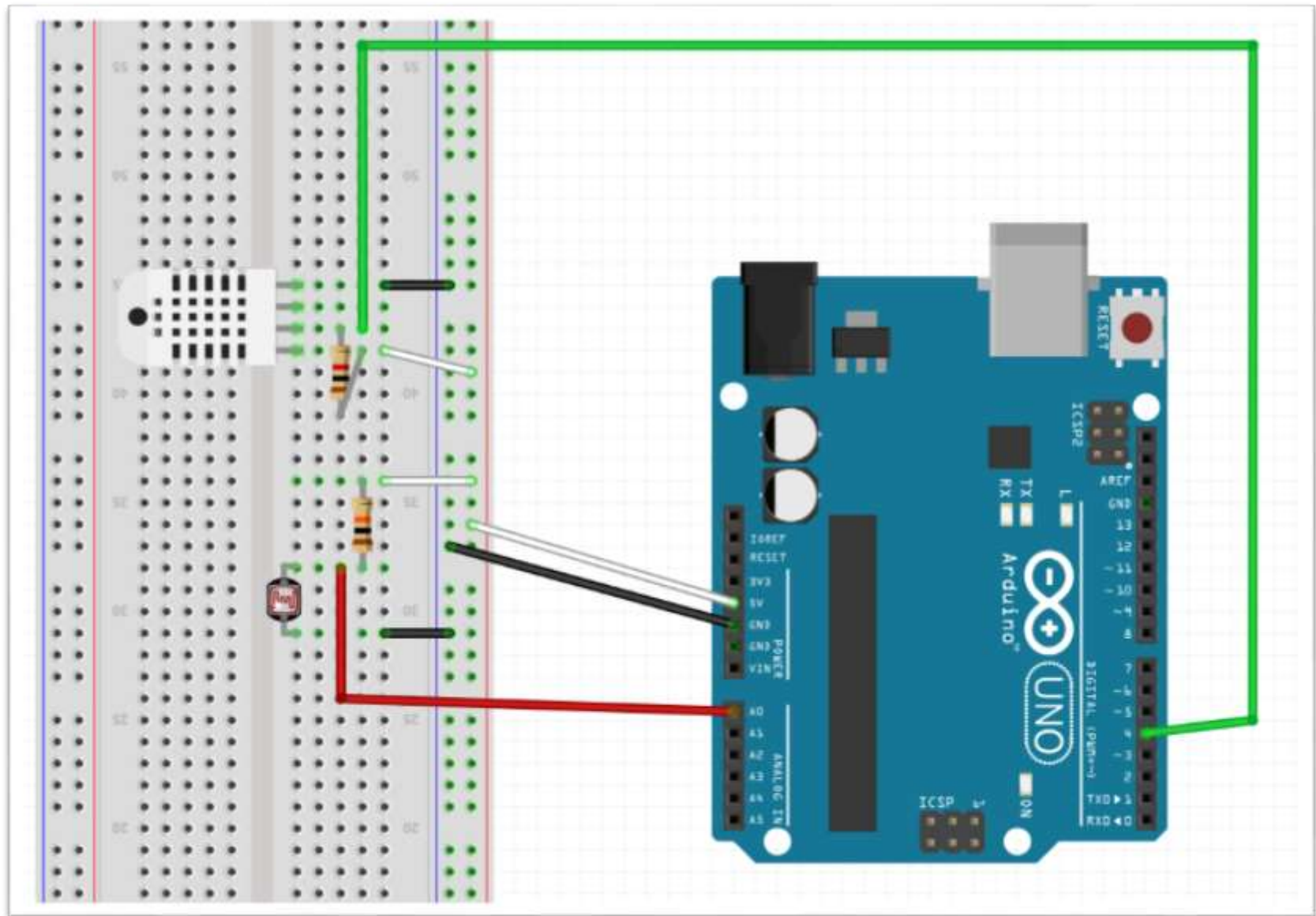


A5.7 DHT22 + CdS streaming project





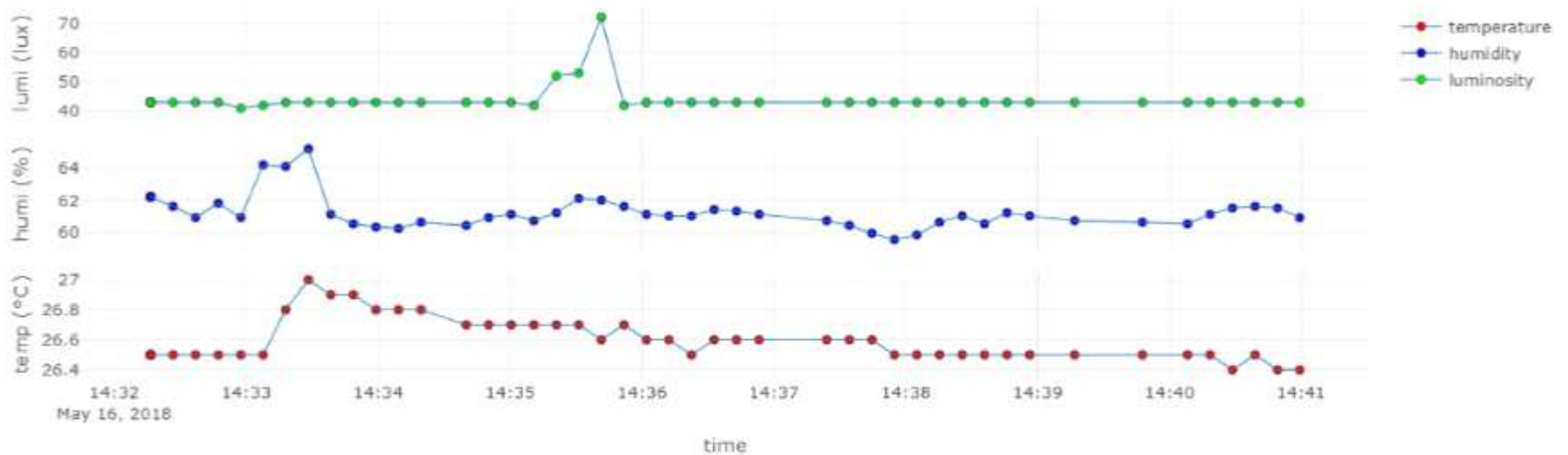
A5.7.1 DHT22 + CdS circuit

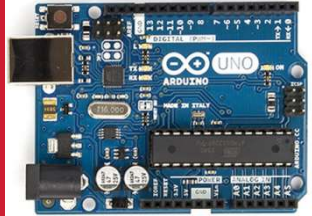


Real-time Weather Station from sensors



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





[Practice]

◆ [wk07]

- RT Data Visualization with node.js
- Usage of gauge.js
- Complete your plotly-node project
- Upload folder: aann-rpt08
- Use repo “aann” in github

wk07 : 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 **AAnn_DS_cds_tmp36.png**
- ⑥ **All *.ino**
- ⑦ **All *.js**
- ⑧ **All *.html**

Email : chaos21c@gmail.com

● 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

Target of this class

Real-time Weather Station from nano 33 BLE sensors



on Time: 2020-09-09 10:27:17.321

