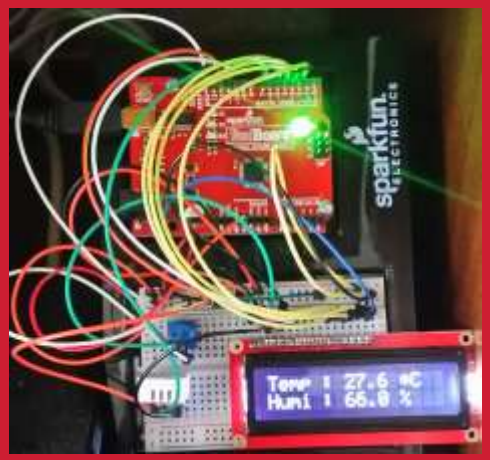
Arduino-IOT

[wk11]



Arduino + Node

Data storaging II

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

Drone-IoT-Comsi, INJE University

2nd semester, 2021

Email : chaos21c@gmail.com

My ID

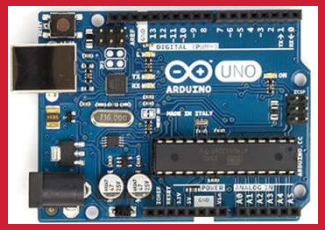
ID를 확인하고 github에 repo 만들기

AA01	김준수	AA13	조재윤
AA02	김현서	AA14	고태승
AA03	박영훈	AA15	이한글
AA04	박윤호	AA16	장세진
AA05	성은지	AA17	장태호
AA06	손윤우	AA18	정지원
AA07	오세윤	AA19	진우태
AA08	우승철	AA20	황혁준
AA09	윤현석	AA21	장이제
AA10	이예주	AA22	박상현
AA11	강지환	AA23	정은성
AA12	성인제	AA24	김경영

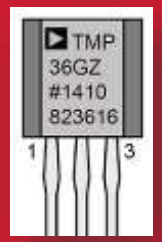
위의 id를 이용해서 github에 repo를 만드시오.

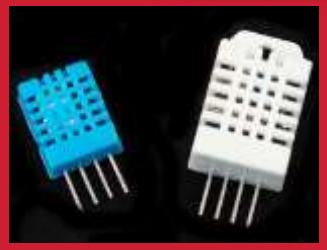
Option: 아두이노응용 실습 과제 – **AAnn**

Public, **README.md check**



[Review]





- [wk10]
  - RT Data storaging with MongoDB
  - Multi-sensor circuits (cds-dht22)
  - Complete your project
  - Upload folder: aann-rpt10

wk10 : Practice : aann-rpt10

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

제출폴더명 : **aann-rpt10**

- 압축할 파일들

① AAnn_mongo_schemas.png

② AAnn_mongo_update.png

③ AAnn_iot_mongodb.png

④ AAnn_iot_mongodb_web.png

⑤ All *.ino

⑥ All *.js

⑦ All *.html

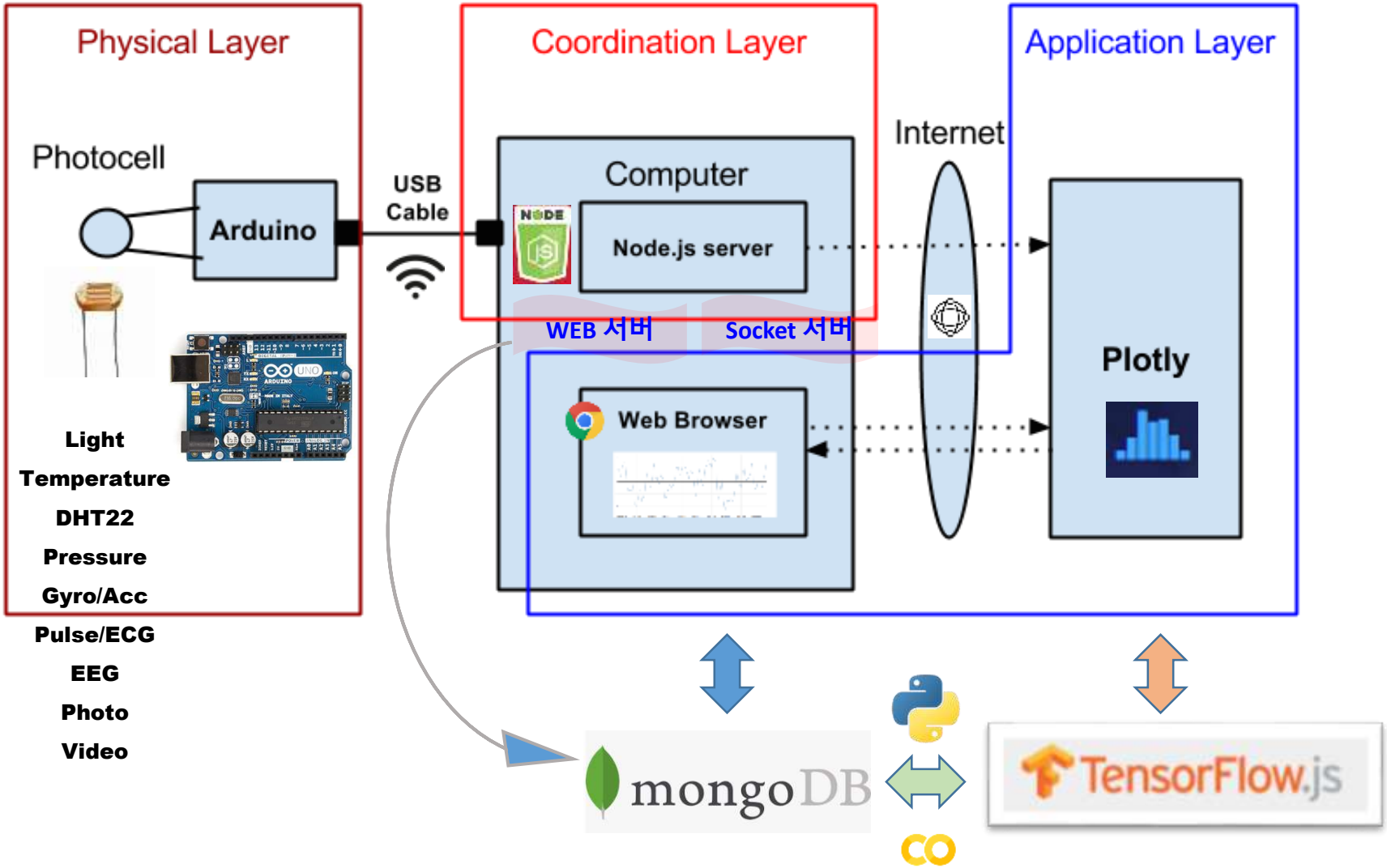
Purpose of AA

주요 수업 목표는 다음과 같다.

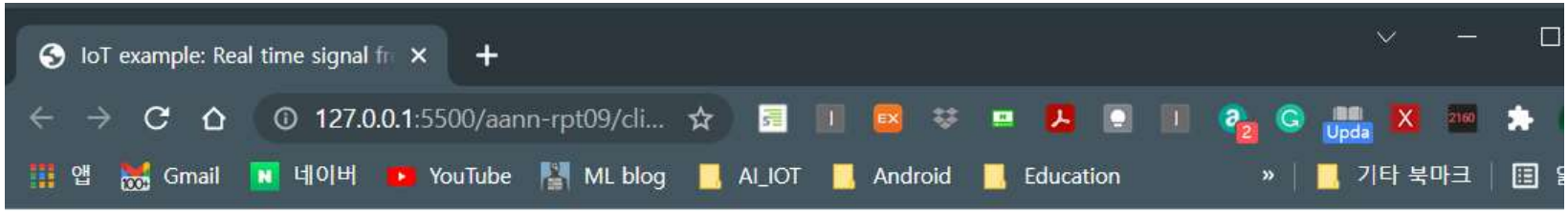
1. Node.js를 이용한 아두이노 센서 신호 처리
2. Plotly.js를 이용한 아두이노 센서 신호 시각화
3. MongoDB에 아두이노 센서 데이터 저장 및 처리

4. 저장된 IoT 데이터의 마이닝 (파이썬 코딩)

Layout [H S C]


Physical Layer
Photocell
Arduino
Light
Temperature
DHT22
Pressure
Gyro/Acc
Pulse/ECG
EEG
Photo
Video
USB
Cable
Coordination Layer
Computer
Node.js server
WEB 서버
Socket 서버
Web Browser
Internet
Application Layer
Plotly
mongoDB
TensorFlow.js

on WEB monitoring Arduino data



IoT Signal from Arduino Weather Station

Real-time Signals

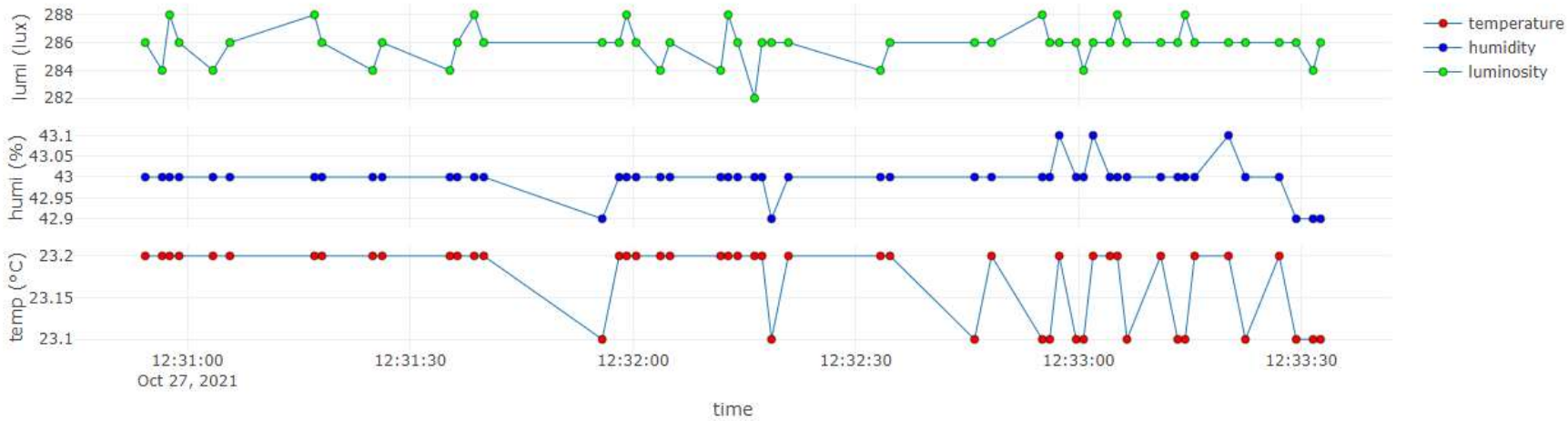
---

on Time: 2021-10-27 11:54:48.997

Signals (온도,습도,조도) : 23.4,42.6,286

Real-time Weather Station from sensors

on Time: 2021-10-27 12:33:32.600



A5. Introduction to IoT service

System (Arduino, sDevice, ...)

↓

Data (signal, image, sns, ...)

↓

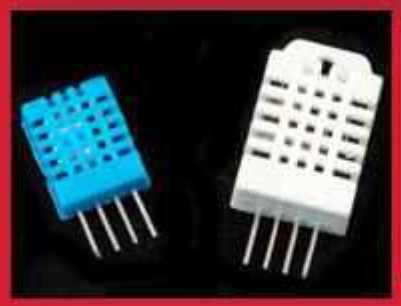
Visualization & monitoring

↓

Data storaging & mining

↓

Service



[Goal]

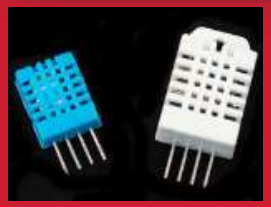
Arduino + Node.js

+ plotly.js

+ MongoDB

→ Data storaging

& visualization



MongoDB from Arduino with node.js & mongoose

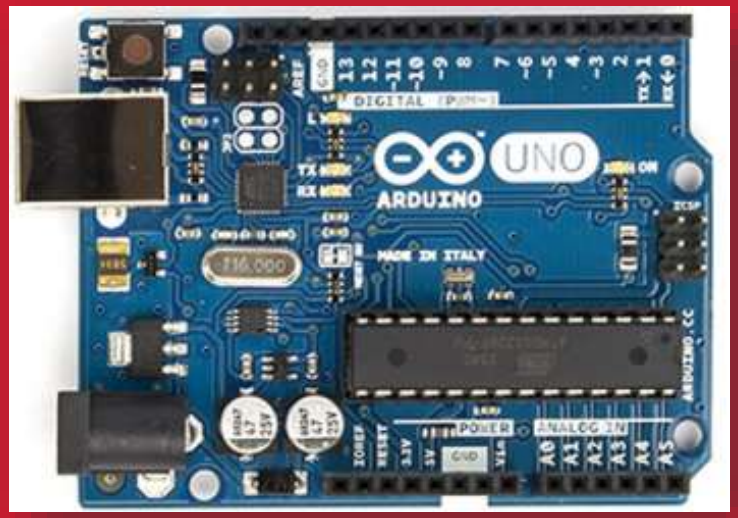
```
> show dbs
aa00     0.000GB
admin    0.000GB
config   0.000GB
iot      0.000GB
iot2     0.000GB
iot3     0.001GB
local    0.000GB
test     0.000GB
test2    0.000GB
>
```

```
mongo db connection OK.
iotInfo: Current date: 2021-11-03 10:52:19.797, Temp: 23.5, Humi: 40.5, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:22.074, Temp: 23.5, Humi: 40.5, Lux: 51
iotInfo: Current date: 2021-11-03 10:52:24.352, Temp: 23.5, Humi: 40.5, Lux: 81
iotInfo: Current date: 2021-11-03 10:52:26.629, Temp: 23.5, Humi: 40.8, Lux: 29
iotInfo: Current date: 2021-11-03 10:52:28.911, Temp: 23.5, Humi: 40.9, Lux: 82
iotInfo: Current date: 2021-11-03 10:52:31.188, Temp: 23.5, Humi: 40.8, Lux: 56
iotInfo: Current date: 2021-11-03 10:52:33.466, Temp: 23.5, Humi: 40.8, Lux: 83
iotInfo: Current date: 2021-11-03 10:52:35.744, Temp: 23.5, Humi: 40.8, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:38.021, Temp: 23.5, Humi: 40.8, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:40.299, Temp: 23.5, Humi: 40.8, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:42.576, Temp: 23.5, Humi: 40.8, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:44.854, Temp: 23.5, Humi: 40.8, Lux: 84
```

Arduino

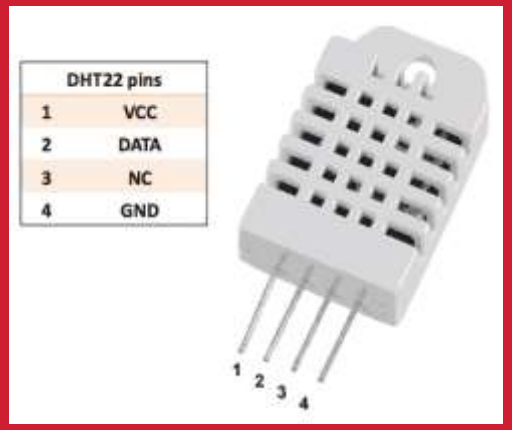
& Node.js

& MongoDB

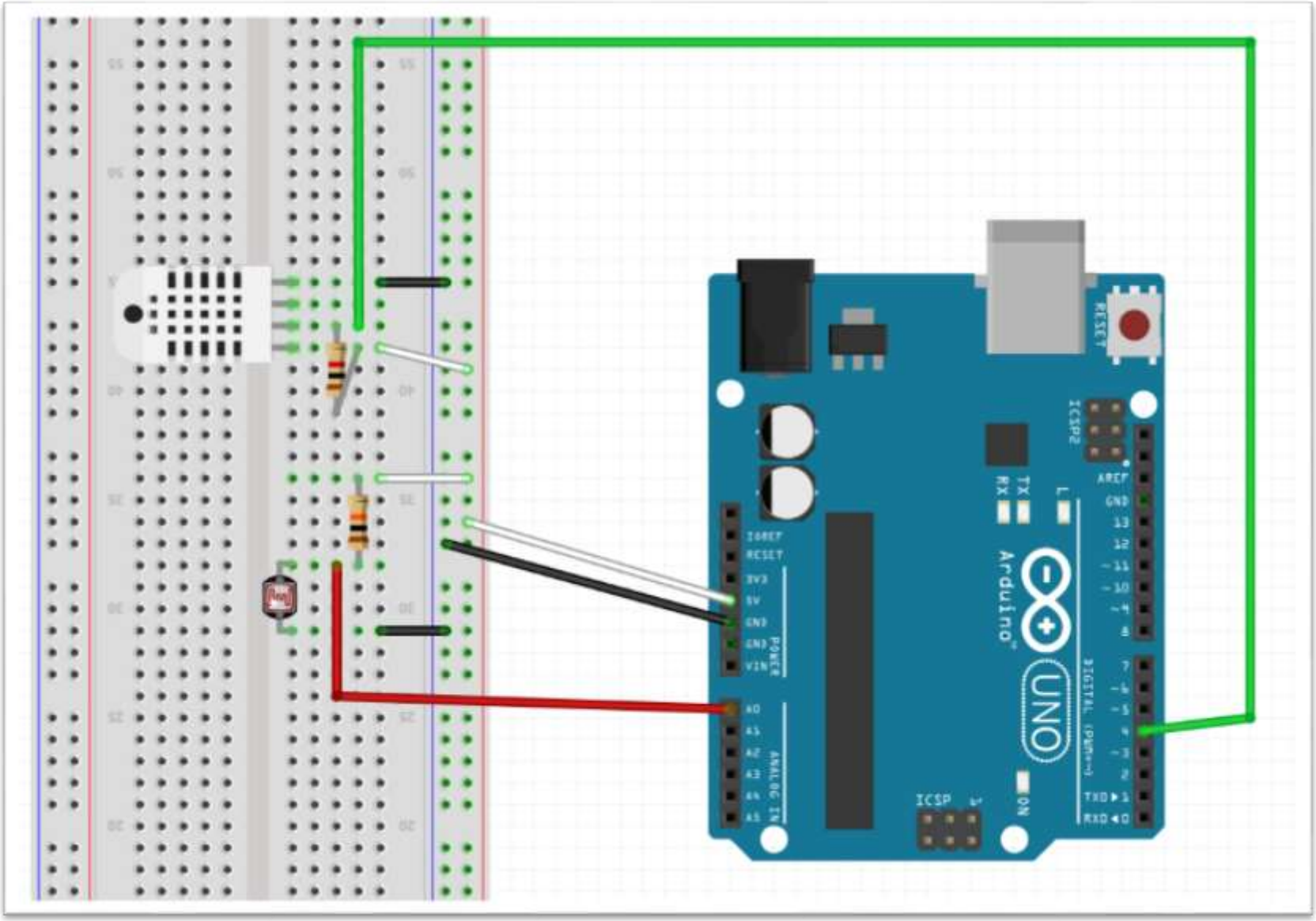


Multi-sensors

DHT22 + CdS



DHT22 + CdS circuit



DHT22[D4] + 1 kΩ, CdS[A0] + 10 k Ω

DHT22 + CdS + Node.js

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

COM3

```
21.0,24.7,205
21.0,24.7,207
21.0,24.7,205
21.0,24.7,152
21.0,24.7,167
20.9,24.6,166
20.9,24.6,204
21.0,24.8,204
21.0,24.8,152
21.0,24.8,173
21.0,24.8,191
21.0,24.8,203
21.0,24.8,207
21.0,24.9,204
21.0,24.9,204
```

☑ 자동 스크롤 ☐ 타임스탬프

문제 출력 디버그 콘솔 터미널 JUPYTER node

```
AAnn,2021-10-27 11:53:01.872,23.4,42.6,286
AAnn,2021-10-27 11:53:02.872,23.4,42.6,286
AAnn,2021-10-27 11:53:04.150,23.4,42.6,286
AAnn,2021-10-27 11:53:05.154,23.4,42.6,286
AAnn,2021-10-27 11:53:06.428,23.4,42.6,286
AAnn,2021-10-27 11:53:07.431,23.4,42.6,286
AAnn,2021-10-27 11:53:08.709,23.4,42.6,286
AAnn,2021-10-27 11:53:09.713,23.4,42.6,286
AAnn,2021-10-27 11:53:10.987,23.4,42.6,286
AAnn,2021-10-27 11:53:11.990,23.4,42.6,286
AAnn,2021-10-27 11:53:13.269,23.4,42.6,284
AAnn,2021-10-27 11:53:14.268,23.4,42.6,284
AAnn,2021-10-27 11:53:15.546,23.4,42.6,286
AAnn,2021-10-27 11:53:16.550,23.4,42.6,284
AAnn,2021-10-27 11:53:17.824,23.4,42.6,286
AAnn,2021-10-27 11:53:18.827,23.4,42.6,286
```

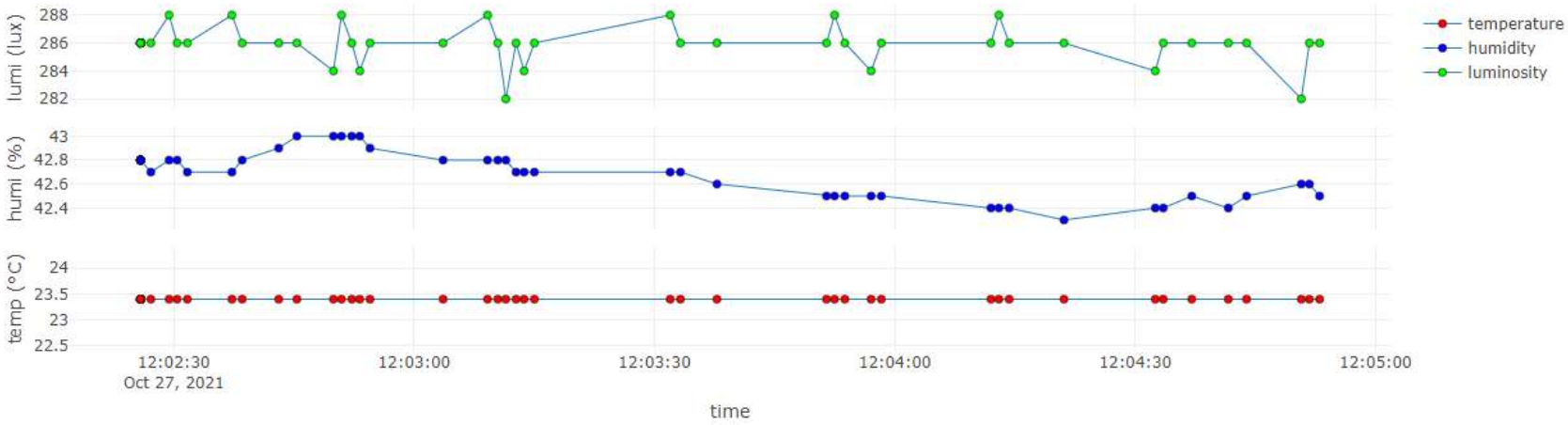
Arduino data on network socket

Real-time monitoring of signals from Arduino CdS + DHT22 circuit

WEB client： client_cds_dht22.html

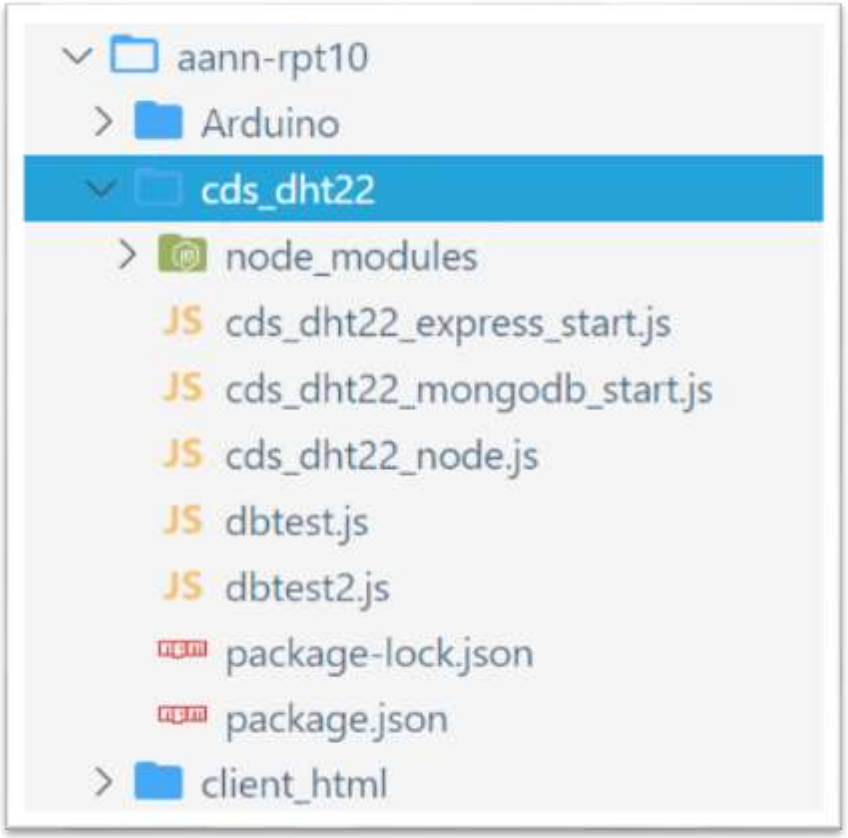
Real-time Weather Station from sensors

on Time: 2021-10-27 12:04:53.016



A5.9.5 DHT22 + CdS + Node.js + MongoDB

1. 작업 폴더 구조 [2021]



A5.9.5 DHT22 + CdS + Node.js + MongoDB

2.1 cds_dht22_mongodb.js

```
1  // cds_dht22_mongodb.js
2
3  var serialport = require('serialport');
4  var portName = 'COM4';  // check your COM port!!
5  var port     =   process.env.PORT || 3000;
6
7  var io = require('socket.io').listen(port);
8
9  // MongoDB
10 var mongoose = require('mongoose');
11 var Schema = mongoose.Schema;
12 // MongoDB connection
13 mongoose.connect('mongodb://localhost:27017/iot'); // DB name
14 var db = mongoose.connection;
15 db.on('error', console.error.bind(console, 'connection error:'));
16 db.once('open', function callback () {
17     console.log("mongo db connection OK.");
18 });
19 // Schema
20 var iotSchema = new Schema({
21     date : String,
22     temperature : String,
23     humidity : String,
24     luminosity: String
25 });
```

A5.9.5 DHT22 + CdS + Node.js + MongoDB

2.2 cds_dht22_mongodb.js

```
23  // Schema
24  var iotSchema = new Schema({
25    date: String,
26    temperature: String,
27    humidity: String,
28    luminosity: String,
29  });
30  // Display data on console in the case of saving data.
31  iotSchema.methods.info = function () {
32    var iotInfo = this.date
33      ? "Current date: " +
34        this.date +
35        ", Temp: " +
36        this.temperature +
37        ", Humi: " +
38        this.humidity +
39        ", Lux: " +
40        this.luminosity
41      : "I don't have a date";
42    console.log("iotInfo: " + iotInfo);
43  };
```

A5.9.5 DHT22 + CdS + Node.js + MongoDB

2.3 cds_dht22_mongodb.js

```
45  const Readline = require("@serialport/parser-readline");
46  // serial port object
47  var sp = new serialport(portName, {
48    baudRate: 9600, // 9600  38400
49    dataBits: 8,
50    parity: "none",
51    stopBits: 1,
52    flowControl: false,
53    parser: new Readline("\r\n"),
54  });
55
56  const parser = sp.pipe(new Readline({ delimiter: "\r\n" }));
57
58  // Read the port data
59  sp.on("open", () => {
60    console.log("serial port open");
61  });
62
63  var readData = ""; // this stores the buffer
64  var temp = "";
65  var humi = "";
66  var lux = "";
67  var mdata = []; // this array stores date and data from multiple sensors
68  var firstcommaidx = 0;
69
70  var Sensor = mongoose.model("Sensor", iotSchema); // sensor data model
```

A5.9.5 DHT22 + CdS + Node.js + MongoDB

2.4 cds_dht22_mongodb.js – parsing data & save data in MongoDB

```
72  parser.on("data", function (data) {
73    // call back when data is received
74    readData = data.toString(); // append data to buffer
75    firstcommaidx = readData.indexOf(",");
76    // parsing data into signals
77    if (readData.lastIndexOf(",") > firstcommaidx && firstcommaidx > 0) {
78      temp = readData.substring(
79        firstcommaidx + 1,
80        readData.indexOf(",", firstcommaidx + 1)
81      );
82      humi = readData.substring(
83        readData.indexOf(",", firstcommaidx + 1) + 1,
84        readData.lastIndexOf(",")
85      );
86      lux = readData.substring(readData.lastIndexOf(",") + 1);
87      readData = "";
88      dStr = getDateString();
89      mdata[0] = dStr; // Date
90      mdata[1] = temp; // temperature data
91      mdata[2] = humi; // humidity data
92      mdata[3] = lux; // luminosity data
93      var iot = new Sensor({
94        date: dStr,
95        temperature: temp,
96        humidity: humi,
97        luminosity: lux,
98      });
99      // save iot data to MongoDB
100     iot.save(function (err, iot) {
101       if (err) return handleEvent(err);
102       iot.info(); // Display the information of iot data  on console.
103     });
104     io.sockets.emit("message", mdata); // send data to all clients
105   } else {
106     // error
107     console.log(readData);
108   }
109 });
```

2.5 cds_dht22_mongodb.js

```
113  io.sockets.on("connection", function (socket) {
114    // If socket.io receives message from the client browser then
115    // this call back will be executed.
116    socket.on("message", function (msg) {
117      console.log(msg);
118    });
119    // If a web browser disconnects from Socket.IO then this callback is called.
120    socket.on("disconnect", function () {
121      console.log("disconnected");
122    });
123  });
124
125  // helper function to get a nicely formatted date string
126  function getDateString() {
127    var time = new Date().getTime();
128    // 32400000 is (GMT+9 Korea, GimHae)
129    // for your timezone just multiply +/-GMT by 3600000
130    var datestr = new Date(time + 32400000)
131      .toISOString()
132      .replace(/T/, " ")
133      .replace(/Z/, "");
134    return datestr;
135  }
```

2.6 [Run] node cds_dht22_mongodb.js

mongo | node | cds_dht22_mongodb.js | dbtest.js | dbtest

```
D:\aann\aann-rpt10\cds_dht22>node cds_dht22_mongodb
serial port open
mongo db connection OK.
iotInfo: Current date: 2021-11-03 10:52:19.797, Temp: 23.5, Humi: 40.5, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:22.074, Temp: 23.5, Humi: 40.5, Lux: 51
iotInfo: Current date: 2021-11-03 10:52:24.352, Temp: 23.5, Humi: 40.5, Lux: 81
iotInfo: Current date: 2021-11-03 10:52:26.629, Temp: 23.5, Humi: 40.8, Lux: 29
iotInfo: Current date: 2021-11-03 10:52:28.911, Temp: 23.5, Humi: 40.9, Lux: 82
iotInfo: Current date: 2021-11-03 10:52:31.188, Temp: 23.5, Humi: 40.8, Lux: 56
iotInfo: Current date: 2021-11-03 10:52:33.466, Temp: 23.5, Humi: 40.8, Lux: 83
iotInfo: Current date: 2021-11-03 10:52:35.744, Temp: 23.5, Humi: 40.8, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:38.021, Temp: 23.5, Humi: 40.8, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:40.299, Temp: 23.5, Humi: 40.8, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:42.576, Temp: 23.5, Humi: 40.8, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:44.854, Temp: 23.5, Humi: 40.8, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:47.136, Temp: 23.5, Humi: 40.8, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:49.413, Temp: 23.5, Humi: 40.7, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:51.691, Temp: 23.5, Humi: 40.7, Lux: 84
iotInfo: Current date: 2021-11-03 10:52:53.969, Temp: 23.5, Humi: 40.7, Lux: 84
```

A5.9.5 DHT22 + CdS + Node.js + MongoDB

3. cds_dht22_mongodb.js → Check documents in Mongo shell

Mongo shell

> show dbs

> use iot

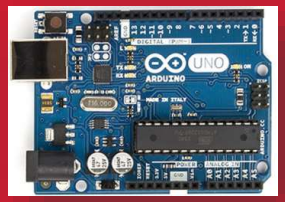
> show collections

> db.sensors.find() .pretty()

mongo | node | cds_dht22_mongodb.js

```
> show dbs
admin    0.000GB
config   0.000GB
iot      0.000GB
local    0.000GB
test     0.000GB
> use iot
switched to db iot
> show collections
sensors
> db.sensors.find().pretty()
{
        "_id" : ObjectId("6181eb5338cdbc755b232170"),
        "date" : "2021-11-03 10:52:19.797",
        "temperature" : "23.5",
        "humidity" : "40.5",
        "luminosity" : "84",
        "__v" : 0
}
{
        "_id" : ObjectId("6181eb5638cdbc755b232172"),
        "date" : "2021-11-03 10:52:22.074",
        "temperature" : "23.5",
        "humidity" : "40.5",
        "luminosity" : "51",
        "__v" : 0
}
{
        "_id" : ObjectId("6181eb5838cdbc755b232174"),
        "date" : "2021-11-03 10:52:24.352",
        "temperature" : "23.5",
        "humidity" : "40.5",
        "luminosity" : "81",
        "__v" : 0
}
```

Save as
AAnn_iot_mongdb.png



Arduino

& Node.js

& MongoDB

& Express server

1.1 Install express server

- Go to cds_dht22 project
- npm install --save express
- package.json

```
D:\aann\aann-rpt10\cds_dht22>npm install --save express
npm WARN cds_dht22@1.0.0 No repository field.

+ express@4.17.1
added 50 packages from 33 contributors, removed 67 packages,
66s

4 packages are looking for funding
  run `npm fund` for details

found 0 vulnerabilities


D:\aann\aann-rpt10\cds_dht22>
```

1.2 Install express server – package.json

- Go to cds_dht22 project
- npm install --save express
- package.json

```
"author": "aa00",
"license": "MIT",
"dependencies": {
  "express": "^4.17.1",
  "mongoose": "^6.0.12",
  "serialport": "^9.2.4",
  "socket.io": "^2.4.1"
}
```

A5.9.6 DHT22 + CdS + Node.js + MongoDB

2.1 cds_dht22_express.js

```
1   // cds_dht22_express.js
2   var express = require("express");
3   var app = express();
4   var web_port = 3030; // express port
5
6   // MongoDB
7   var mongoose = require("mongoose");
8   var Schema = mongoose.Schema; // Schema object
9   // MongoDB connection
10  mongoose.connect("mongodb://localhost:27017/iot", {
11    useNewUrlParser: true,
12    useUnifiedTopology: true,
13  });
14  var db = mongoose.connection;
15  db.on("error", console.error.bind(console, "connection error:"));
16  db.once("open", function callback() {
17    console.log("mongo db connection OK.");
18  });
19  // Schema
20  var iotSchema = new Schema({
21    date: String,
22    temperature: String,
23    humidity: String,
24    luminosity: String,
25  });
26  var Sensor = mongoose.model("Sensor", iotSchema); // sensor data model
```

A5.9.6 DHT22 + CdS + Node.js + MongoDB

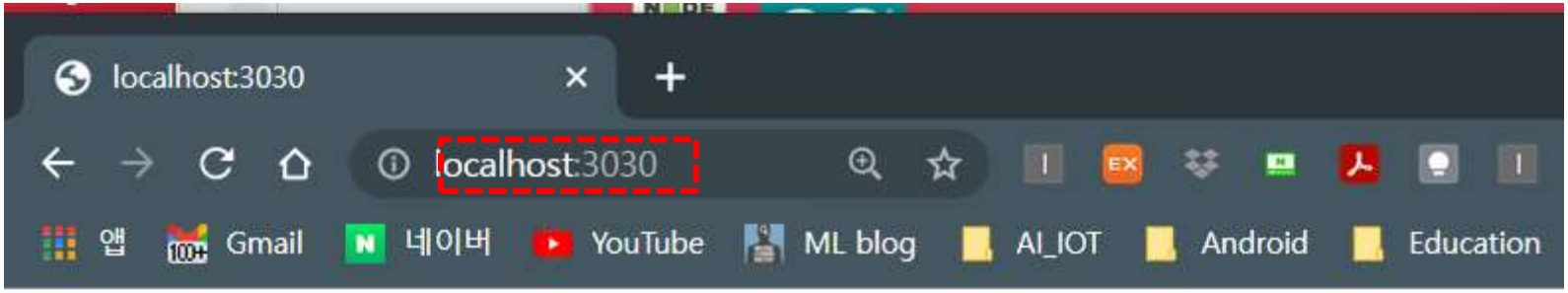
2.2 cds_dht22_express.js

```
28  // Web routing address
29  app.get("/", function (req, res) {
30    // localhost:3030/
31    res.send("Hello Arduino IOT: express server by AA00!");
32  });
33  // find all data & return them
34  app.get("/iot", function (req, res) {
35    Sensor.find(function (err, data) {
36      res.json(data);
37    });
38  });
39  // find data by id
40  app.get("/iot/:id", function (req, res) {
41    Sensor.findById(req.params.id, function (err, data) {
42      res.json(data);
43    });
44  });
45
46  // Express WEB
47  app.use(express.static(__dirname + "/public")); // WEB root folder
48  app.listen(web_port); // port 3030
49  console.log("Express_IOT is running at port:3030");
```

2.3 [Run] node cds_dht22_express.js

```
(base) D:\aann\aann-rpt10\cds_dht22>node cds_dht22_express
Express_IOT is running at port:3030
mongo db connection OK.
```

2.4 cds_dht22_express.js → routing1, http://localhost:3030/



Hello Arduino IOT: express server by AA00!

A5.9.6 DHT22 + CdS + Node.js + MongoDB

2.5 cds_dht22_express.js → routing2 http://localhost:3030/iot

localhost:3030 | localhost:3030/iot

localhost:3030/iot

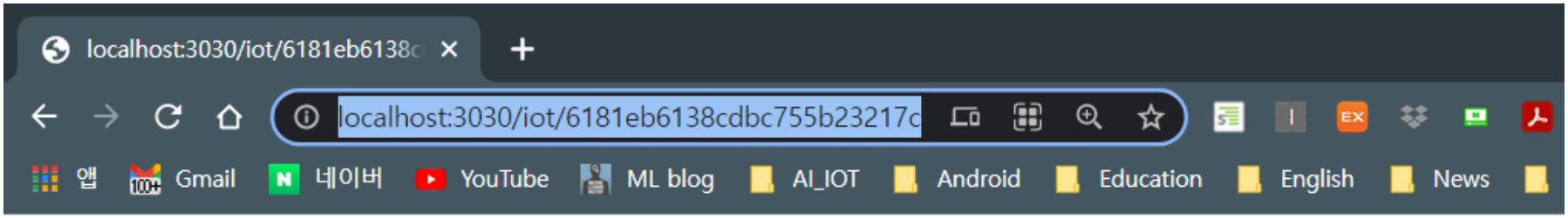
앱 Gmail 네이버 YouTube ML blog AI_IOT Android Education » 기타 북마크


```
[{"_id":"6181eb5338cdbc755b232170","date":"2021-11-03
10:52:19.797","temperature":"23.5","humidity":"40.5","luminosity":"84","__v":0},
{"_id":"6181eb5638cdbc755b232172","date":"2021-11-03
10:52:22.074","temperature":"23.5","humidity":"40.5","luminosity":"51","__v":0},
{"_id":"6181eb5838cdbc755b232174","date":"2021-11-03
10:52:24.352","temperature":"23.5","humidity":"40.5","luminosity":"81","__v":0},
{"_id":"6181eb5a38cdbc755b232176","date":"2021-11-03
10:52:26.629","temperature":"23.5","humidity":"40.8","luminosity":"29","__v":0},
{"_id":"6181eb5c38cdbc755b232178","date":"2021-11-03
10:52:28.911","temperature":"23.5","humidity":"40.9","luminosity":"82","__v":0},
{"_id":"6181eb5f38cdbc755b23217a","date":"2021-11-03
10:52:31.188","temperature":"23.5","humidity":"40.8","luminosity":"56","__v":0},
{"_id":"6181eb6138cdbc755b23217c","date":"2021-11-03
10:52:33.466","temperature":"23.5","humidity":"40.8","luminosity":"83","__v":0},
{"_id":"6181eb6338cdbc755b23217e","date":"2021-11-03
10:52:35.744","temperature":"23.5","humidity":"40.8","luminosity":"84","__v":0},
{"_id":"6181eb6638cdbc755b232180","date":"2021-11-03
10:52:38.021","temperature":"23.5","humidity":"40.8","luminosity":"84","__v":0},
{"_id":"6181eb6838cdbc755b23218
```


Save as AAnn_iot_mongodb_web.png

A5.9.6 DHT22 + CdS + Node.js + MongoDB

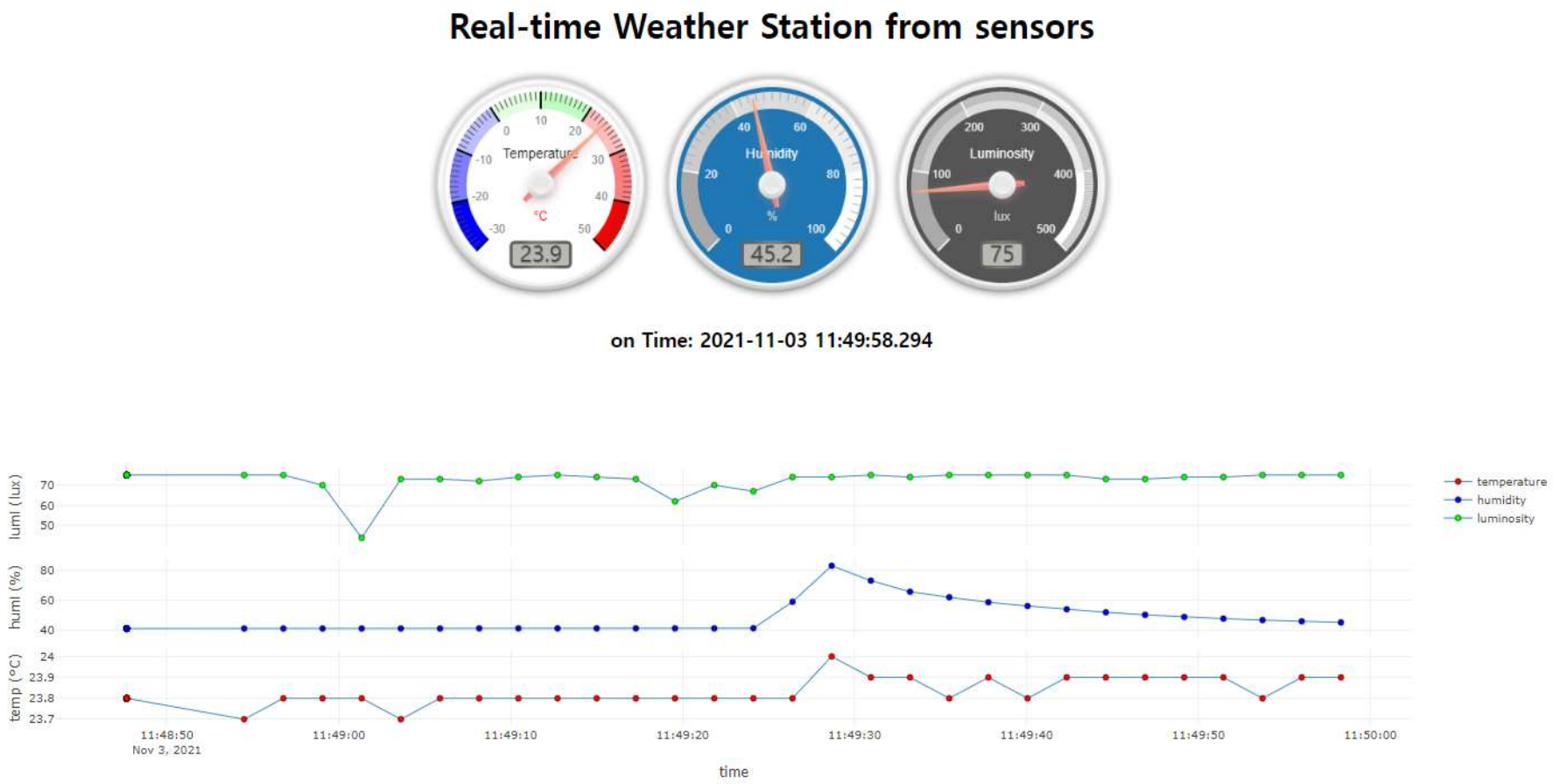
2.6 cds_dht22_express.js → routing2 http://localhost:3030/iot:id



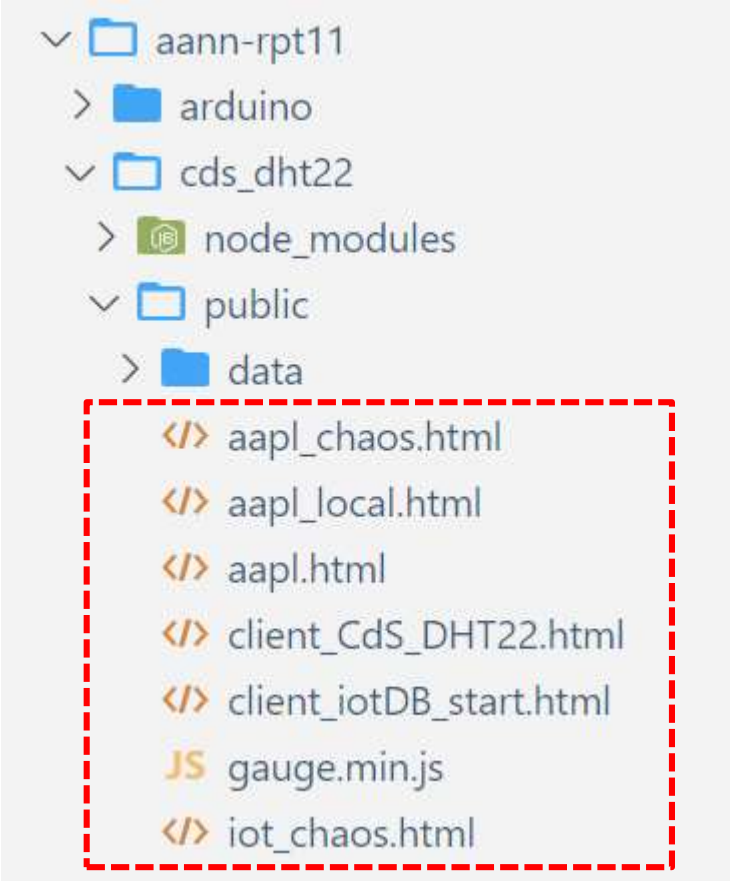
{"_id":"6181eb6138cdbc755b23217c","date":"2021-11-03 10:52:33.466","temperature":"23.5","humidity":"40.8","luminosity":"83","__v":0}

A5.9.6 DHT22 + CdS + Node.js + MongoDB

2.7 copy cds_dht22_client.html & gauge.min.js → ./public/ subfolder
http://localhost:3030/client_cds_dht22.html (web root folder)



2.8 CORS bug (Cross Origin Resource Sharing)



*** CORS problem**

→ 원격 서버 내의 파일에 접근을 허용

A5.9.6 DHT22 + CdS + Node.js + MongoDB

2.9 CORS patch on the express server → cds_dht22_express.js
Node cmd에서 'cors' module 설치 (version 2.8.4 이상)
npm install --save cors

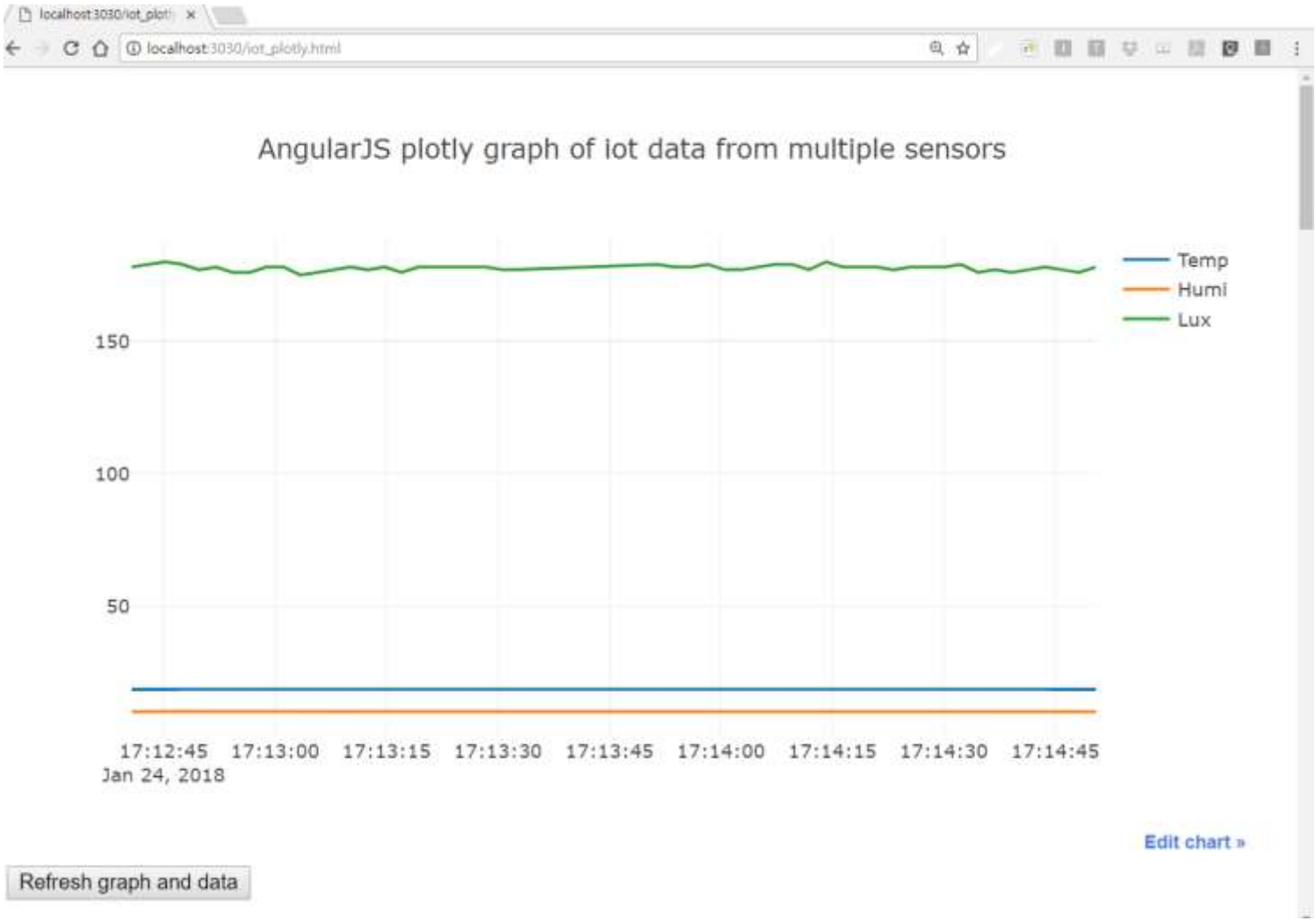
```
// cds_dht22_express_cors.js
// Express + CORS
var express = require("express");
var cors = require("cors");
var app = express();
app.use(cors());
var web_port = 3030; // express port

// MongoDB
var mongoose = require("mongoose");
var Schema = mongoose.Schema; // Schema object
```

```
D:\aann\aann-rpt11\cds_dht22>node cds_dht22_express
Express_IOT with CORS is running at port:3030
mongo db connection OK.
```

Web monitoring

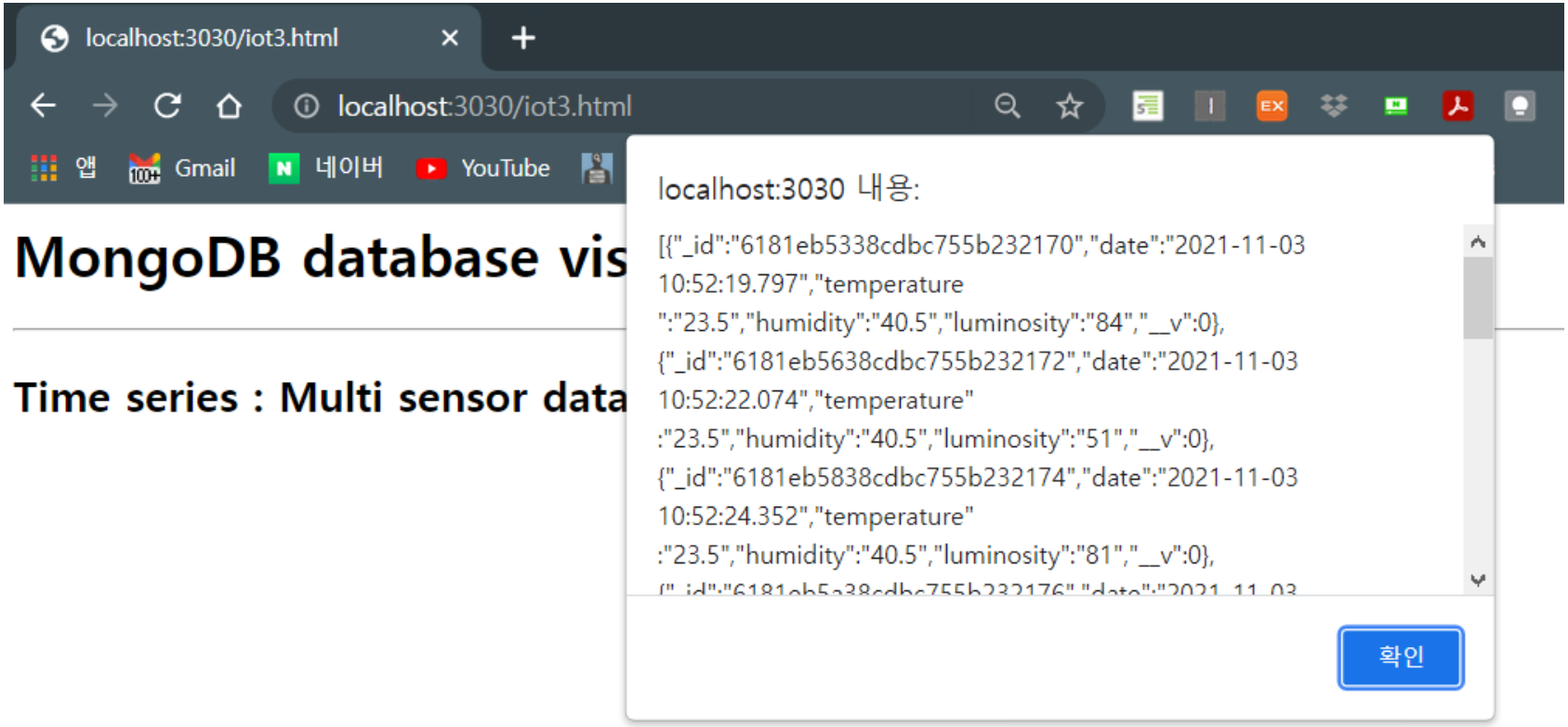
DHT22 + CdS + Node.js + MongoDB

Web monitoring – Google AngularJS



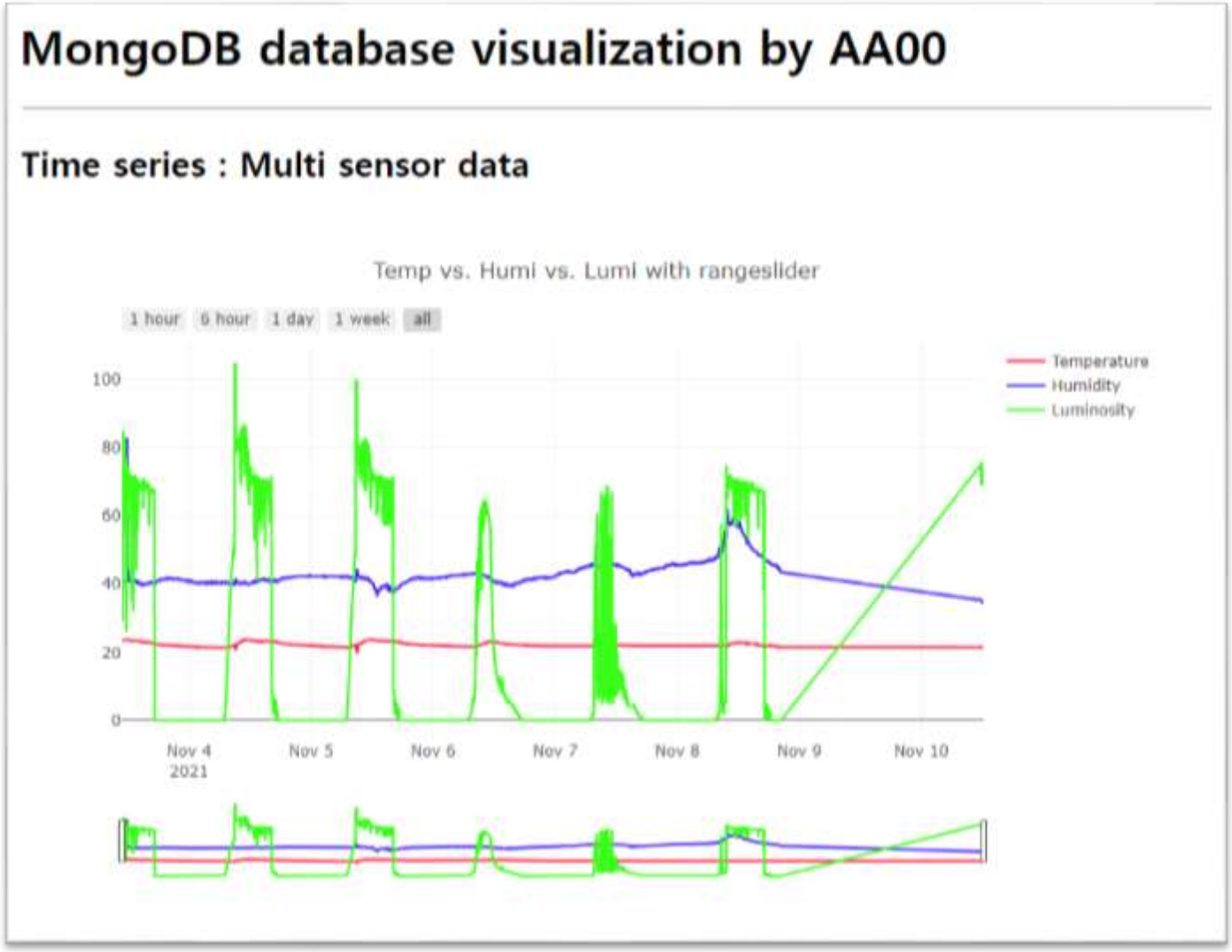
DHT22 + CdS + Node.js + MongoDB

Web monitoring: http://localhost:3030/iot



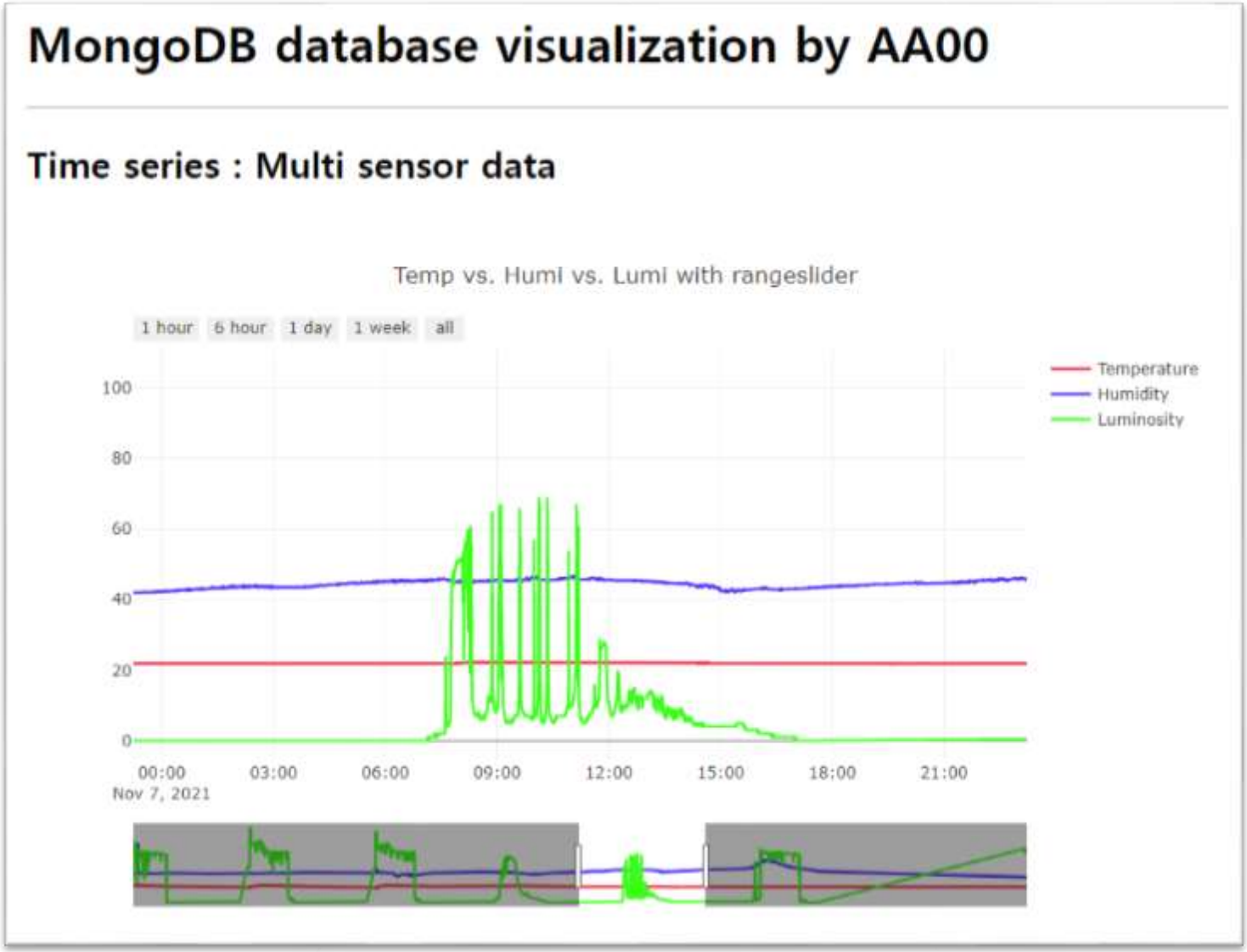
DHT22 + CdS + Node.js + MongoDB

Web monitoring



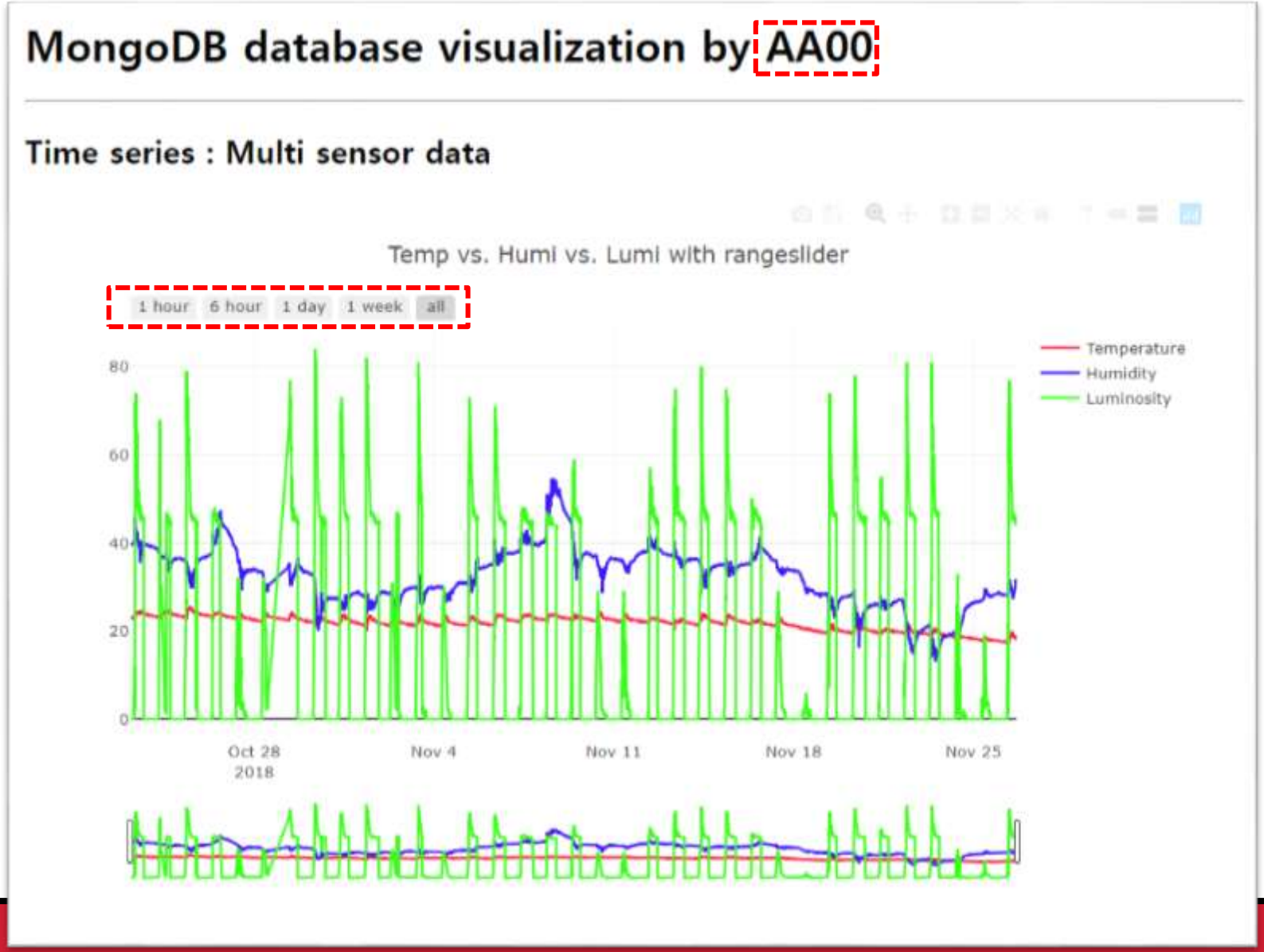
DHT22 + CdS + Node.js + MongoDB

Web monitoring



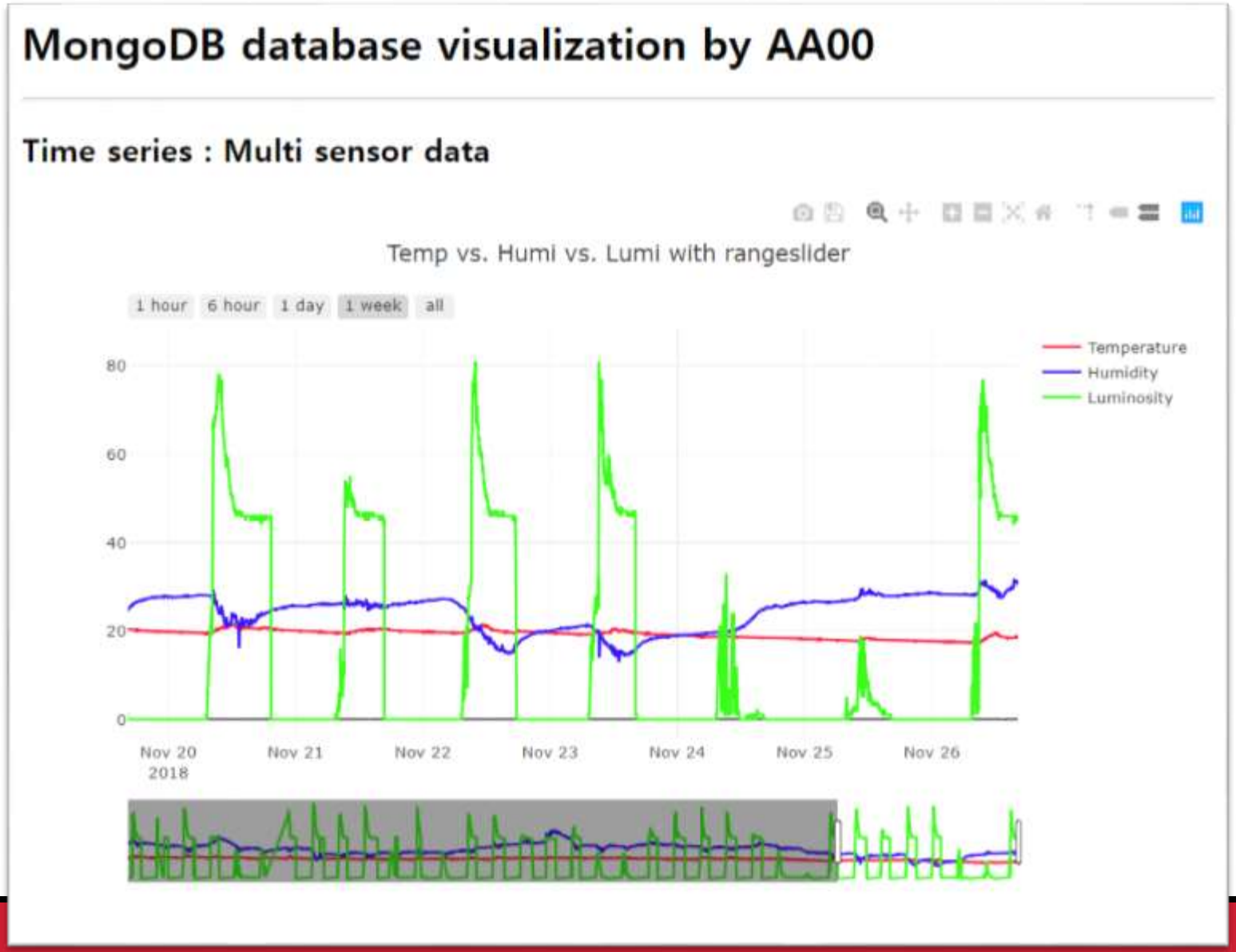
A5.9.7 DHT22 + CdS + Node.js + MongoDB

3.5 Web client: client_iotDB.html – iot DB monitoring (public 폴더에서 제공)



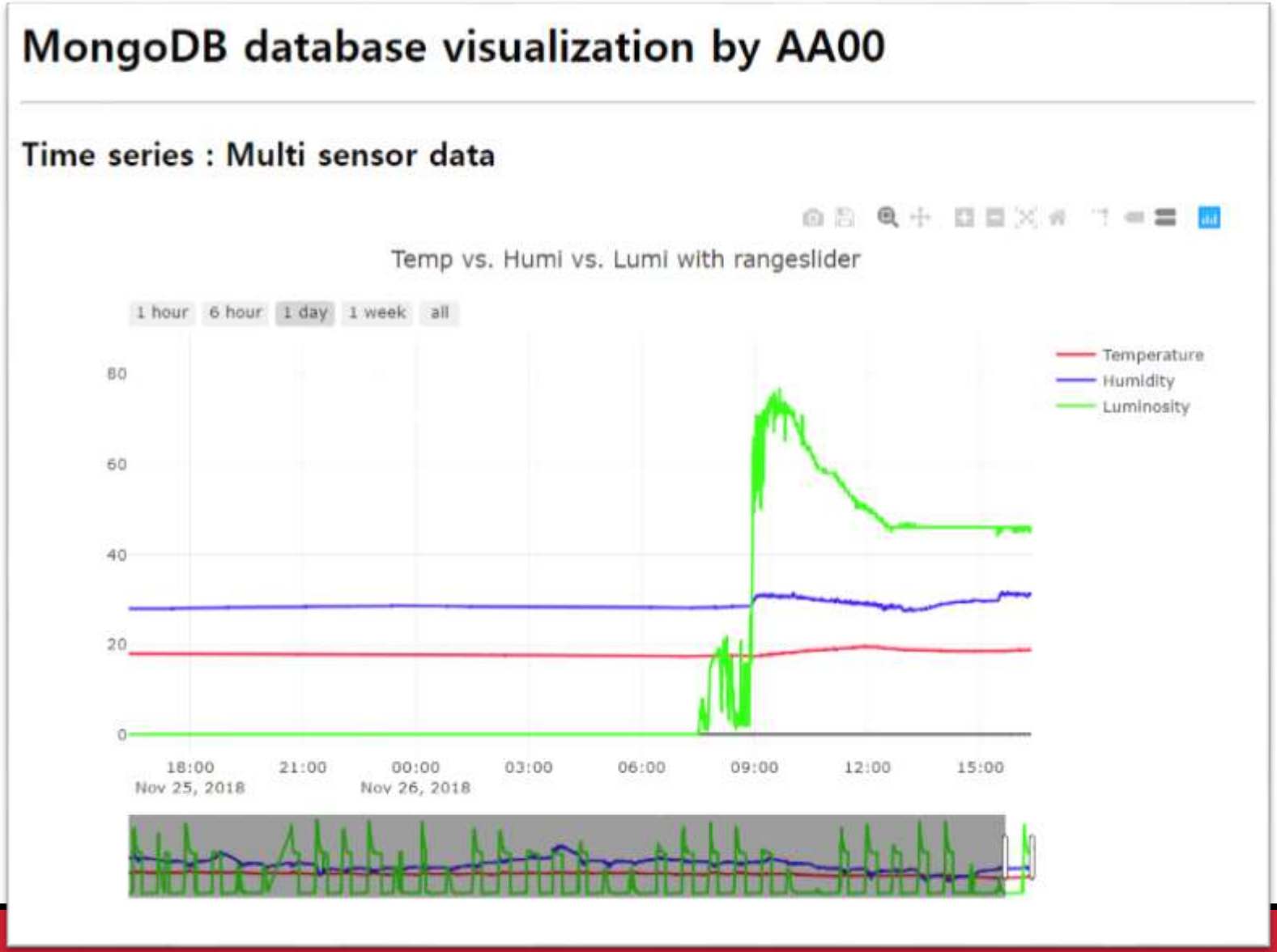
A5.9.7 DHT22 + CdS + Node.js + MongoDB

Web monitoring-2: week



A5.9.7 DHT22 + CdS + Node.js + MongoDB

Web monitoring-3: day



A5.9.8 DHT22 + CdS + Node.js + MongoDB

3.1 Web client: client_iotDB.html

client_iotDB.html

```html
<!DOCTYPE html>
<head>
    <meta charset="utf-8">
    <!-- Plotly.js -->
    <script src="https://cdn.plot.ly/plotly-latest.min.js"></script>
</head>
<body>
    <h1>MongoDB database visualization by AA00</h1>
    <hr>
    <h2>Time series : Multi sensor data</h2>

    <!-- Plotly chart will be drawn inside this DIV -->
    <div id="myDiv" style="width: 900px;height: 600px"></div>

```

A5.9.7 DHT22 + CdS + Node.js + MongoDB

3.2 Web client: client_iotDB.html

```
<script>
    <!-- JAVASCRIPT CODE GOES HERE -->

    Plotly.d3.json("http://localhost:3030/iot", function(err, json){
        //alert(json);
         alert(JSON.stringify(json));  // It works!!!
        //alert(JSON.parse(eval(json));
        if(err) throw err;

        var date = [];
        var temp = [];
        var humi = [];
        var lumi = [];
        var jsonData = eval(JSON.stringify(json));
        //alert(jsonData.length);
        //alert(jsonData[2].luminosity);

        for (var i = 0; i < jsonData.length; i++) {
            date[i] = jsonData[i].date;
            temp[i] = jsonData[i].temperature ;
            humi[i] = jsonData[i].humidity;
            lumi[i] = jsonData[i].luminosity;

        }
```

JSON file


```
{"_id":"5fbdab71d02de805786af43c","date":"2020-11-25
09:55:13.068","temperature":"18.9","humidity":"24.7","luminosity":"207","__v":0},
{"_id":"5fbdab73d02de805786af43d","date":"2020-11-25
09:55:15.341","temperature":"18.9","humidity":"24.7","luminosity":"208","__v":0},
{"_id":"5fbdab75d02de805786af43e","date":"2020-11-25
```

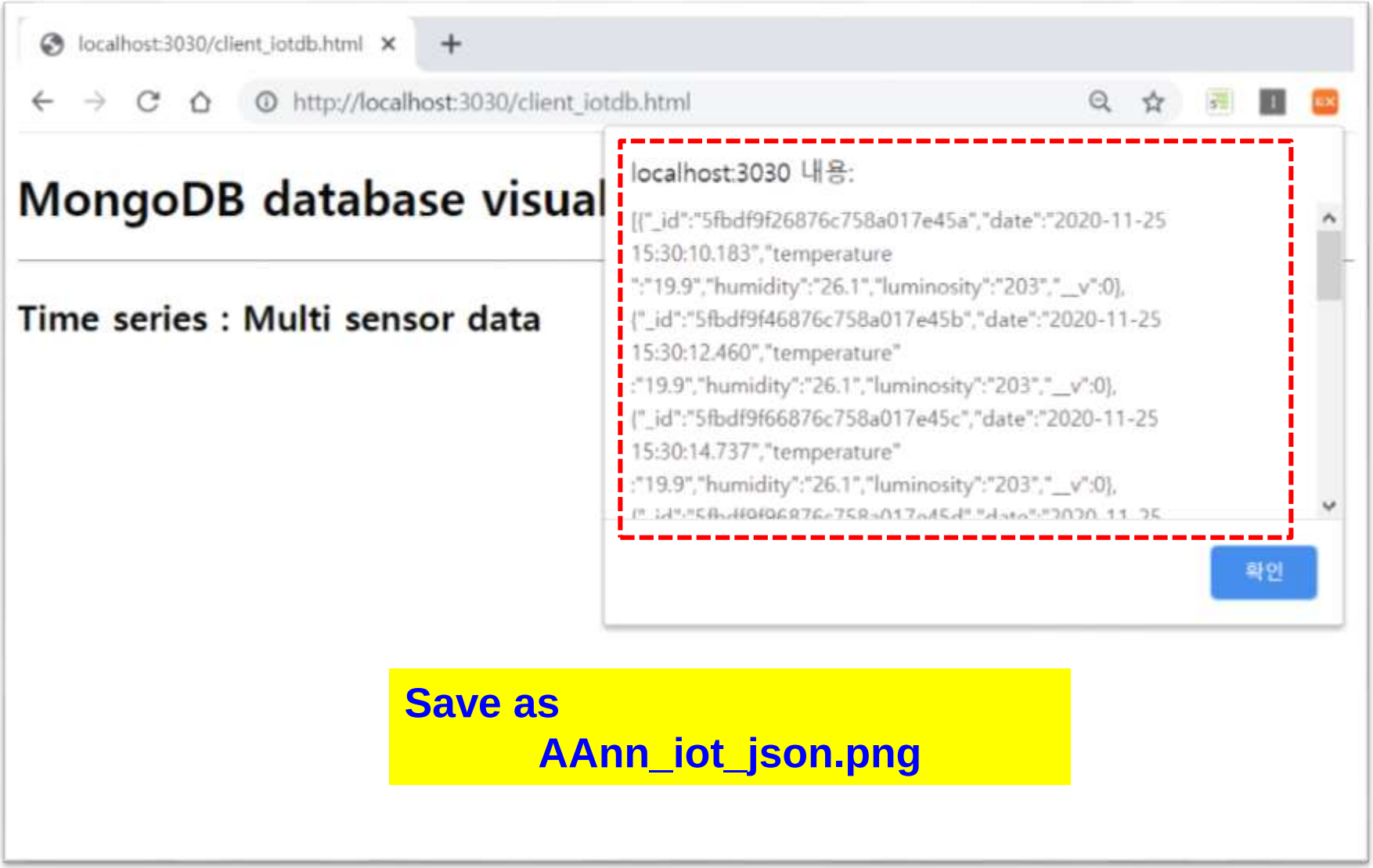
3.3 Web client: client_iotDB.html – data & layout

```
// time series of sensor data
var trace1 = {
    type: "scatter",
    mode: "lines",
    name: 'Temperature',
    x: date,
    y: temp,
    line: {color: '#fc1234'}
}

var trace2 = {
    type: "scatter",
    mode: "lines",
    name: 'Humidity',
    x: date,
    y: humi,
    line: {color: '#3412fc'}
}
var trace3 = {
    type: "scatter",
    mode: "lines",
    name: 'Luminosity',
    x: date,
    y: lumi,
    line: {color: '#34fc12'}
}
var data = [trace1, trace2, trace3];
```

```
// Layout with builtin rangeslider
var layout = {
    title: 'Temp vs. Humi vs. Lumi with rangeslider',
    xaxis: {
        autorange: true,
        range: [date[0], date[date.length-1]],
        rangeselector: {buttons: [
            {
                count: 1,
                label: '1 hour',
                step: 'hour',
                stepmode: 'backward'
            },
            {
                count: 6,
                label: '6 hour',
                step: 'hour',
                stepmode: 'backward'
            },
            {
                count: 24,
                label: '1 day',
                step: 'hour',
                stepmode: 'backward'
            },
            {
                count: 7,
                label: '1 week',
                step: 'day',
                stepmode: 'backward'
            },
            {step: 'all'}
            ]},
            rangeslider: {range: [date[0], date[date.length-1]]},
            type: 'date'
        },
        yaxis: {
            autorange: true,
            range: [0, 300],
            type: 'linear'
        }
    };

    Plotly.newPlot('myDiv', data, layout);
})
```

A5.9.7 DHT22 + CdS + Node.js + MongoDB

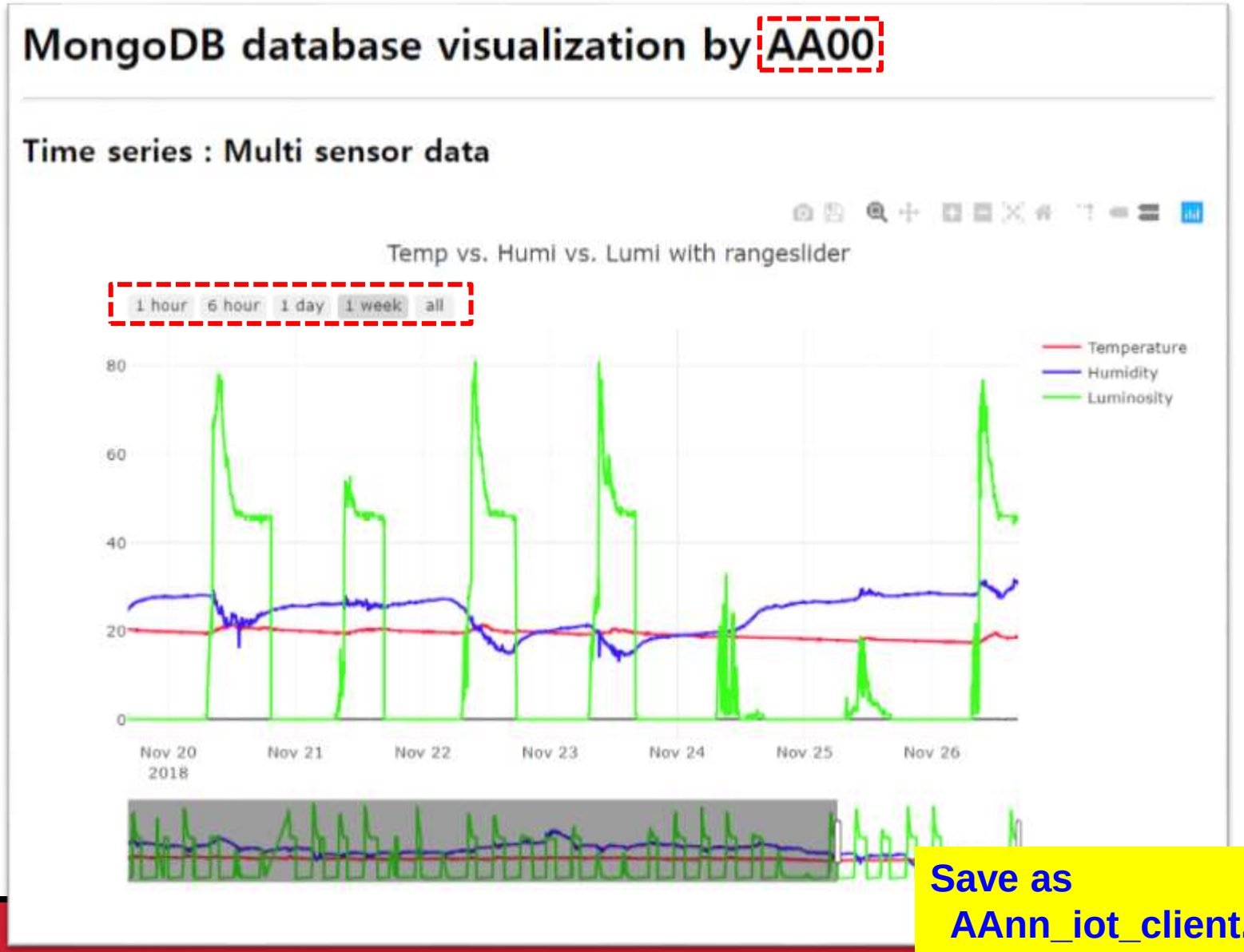
3.4 Web client: client_iotDB.html – load iot data in json file



Save as
AAnn_iot_json.png

A5.9.7 DHT22 + CdS + Node.js + MongoDB

3.5 Web client: client_iotDB.html – iot DB monitoring



Save as AAnn_iot_client.png

MongoDB data management

- Query in mongo shell
- Export & import MongoDB
- Using and understanding iot data with Python (or R)

A5.9.8 MongoDB management

1. Query in Mongo shell (문서 검색)

db.sensors.count() → sensors collection에 있는 도큐먼트 (문서)의 수

db.sensors.find().sort({_id: 1}).limit(10) → 오래된 document 10개 추출

db.sensors.find().sort({_id: -1}).limit(10) → 최근 document 10개 추출

db.sensors.find({date: {$gt: “2021-11-10 15:16:05”}}) → 특정 시간 이후 document 추출

db.sensors.find({temperature: {$gt: “25”}}) → 온도가 25도를 넘는 document 추출

https://docs.mongodb.com/manual/tutorial/query-documents/

A5.9.8 MongoDB management

2. Import or export MongoDB (VSCode 터미널에서 실행)

- mongoimport --d=dbName --c=collectionName --type=csv --headerline --file= fileName.csv

- mongoexport --d=dbName --c=collectionName --fields=<field1,field2,…> --limit=nn --type=csv --out=fileName.csv

json 또는 csv 파일로 import/export

[Help] mongoimport --help

https://docs.mongodb.com/manual/reference/program/mongoimport/

https://docs.mongodb.com/manual/reference/program/mongoexport/

A5.9.8 MongoDB management

- **mongoimport /db:dbName /collection:collectionName /type:csv /headerline /file: fileName.csv**

```
D:\aann\aann-rpt11\cds_dht22\public\data>mongoimport /db:iot10 /collection:sensors
/type:csv /headerline /file:sensor10.csv
2021-11-10T12:52:08.616+0900    connected to: mongodb://localhost/
2021-11-10T12:52:08.803+0900    10 document(s) imported successfully. 0 document(s)
 failed to import.
```

Import sensor10.csv to MongoDB: iot10

```
> show dbs
admin   0.000GB
config  0.000GB
iot     0.009GB
iot10   0.000GB
local   0.000GB
test    0.000GB
> use iot10
switched to db iot10
```

A5.9.8 MongoDB management

[Tip] iot db의 최근 데이터 500개를 csv 파일 (iot_s500.csv)로 저장할 때,

- **mongoexport /db:iot /collection:sensors /sort:"{_id: -1}" /limit:500 /fields:date,temperature,humidity,luminosity /type:csv /out:iot_s500.csv**

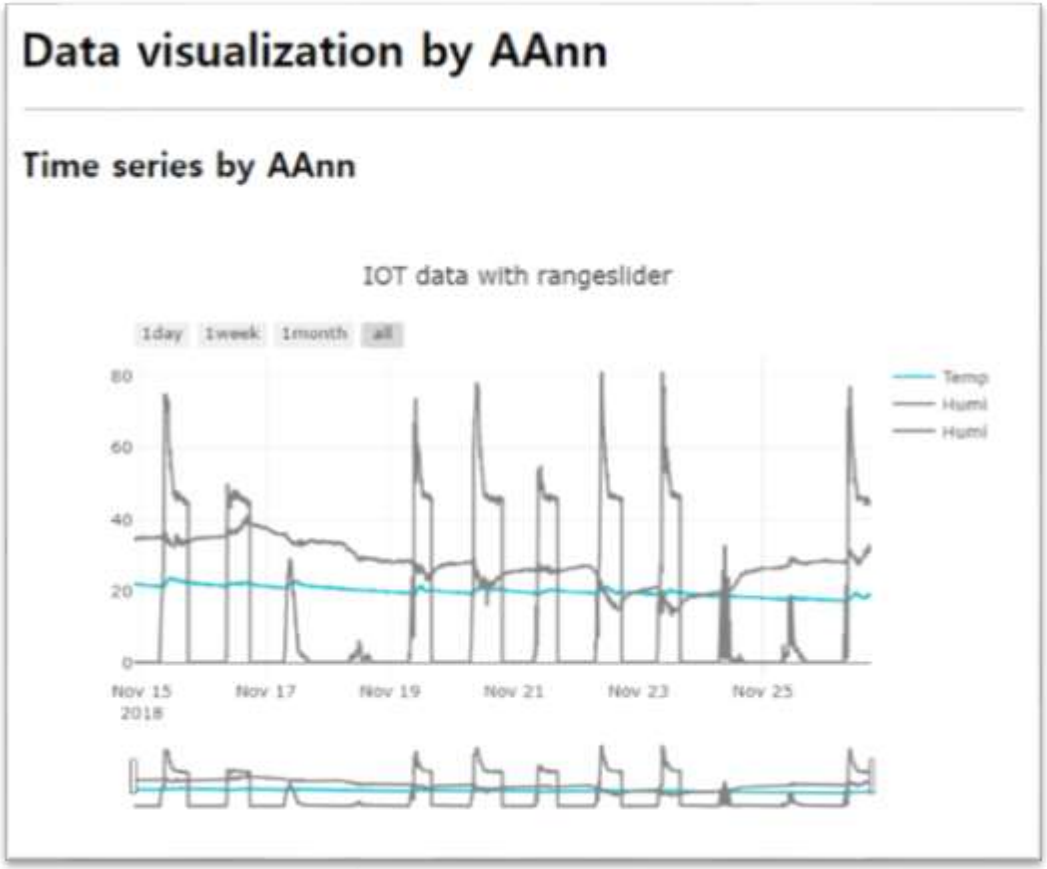
```
D:\aann\aann-rpt11\cds_dht22\public\data>mongoexport /db:iot /collection:sensors
 /sort:"{_id: -1}" /limit:500 /fields:date,temperature,humidity,luminosity /type
:csv /out:iot_s500.csv
2021-11-10T13:08:45.875+0900    connected to: mongodb://localhost/
2021-11-10T13:08:45.941+0900    exported 500 records
```

```
D:\aann\aann-rpt11\cds_dht22\public\data>dir
 D 드라이브의 볼륨: DATA
 볼륨 일련 번호: 82D1-4852

 D:\aann\aann-rpt11\cds_dht22\public\data 디렉터리

2021-11-10  오후 01:08    <DIR>          .
2021-11-10  오후 01:08    <DIR>          ..
2017-11-16  오전 09:58            60,220 aapl.csv
2018-11-26  오후 05:50         3,628,861 iot_chaos.csv
2021-11-10  오후 01:08            18,537 iot_s500.csv
2017-11-16  오후 01:18           135,008 ppg5k.csv
2018-05-26  오후 12:52               397 sensor10.csv
               5개 파일           3,843,023 바이트
               2개 디렉터리  2,410,432,798,720 바이트 남음
```

A5.9.8 MongoDB management

[DIY]

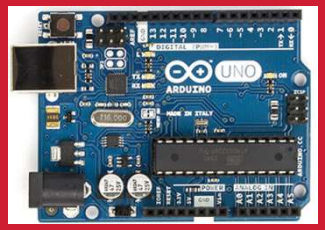
1. iot db의 최근 데이터 1000개를 csv 파일 (AAnn_s1000.csv)로 저장하시오.
2. 저장된 AAnn_s1000.csv 파일을 public/data 폴더에 복사.
3. csv 파일을 이용하는 Rangeslider가 포함된 웹 클라이언트 client_iot.html 파일을 만드시오.
4. Localhost:3030/client_iot.html 로 실행하고 확인.



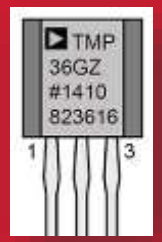
iot_chaos.html을

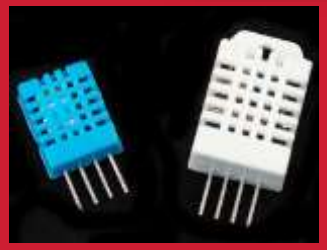
client_iot.html로

이름 변경해서 코드를 완성하시오.



[Practice]





- [wk11]
  - RT Data visualization with MongoDB
  - Multi-sensor circuits (cds-dht22)
  - Complete your project
  - Upload folder: aann-rpt11
  - Use repo “aann” in github

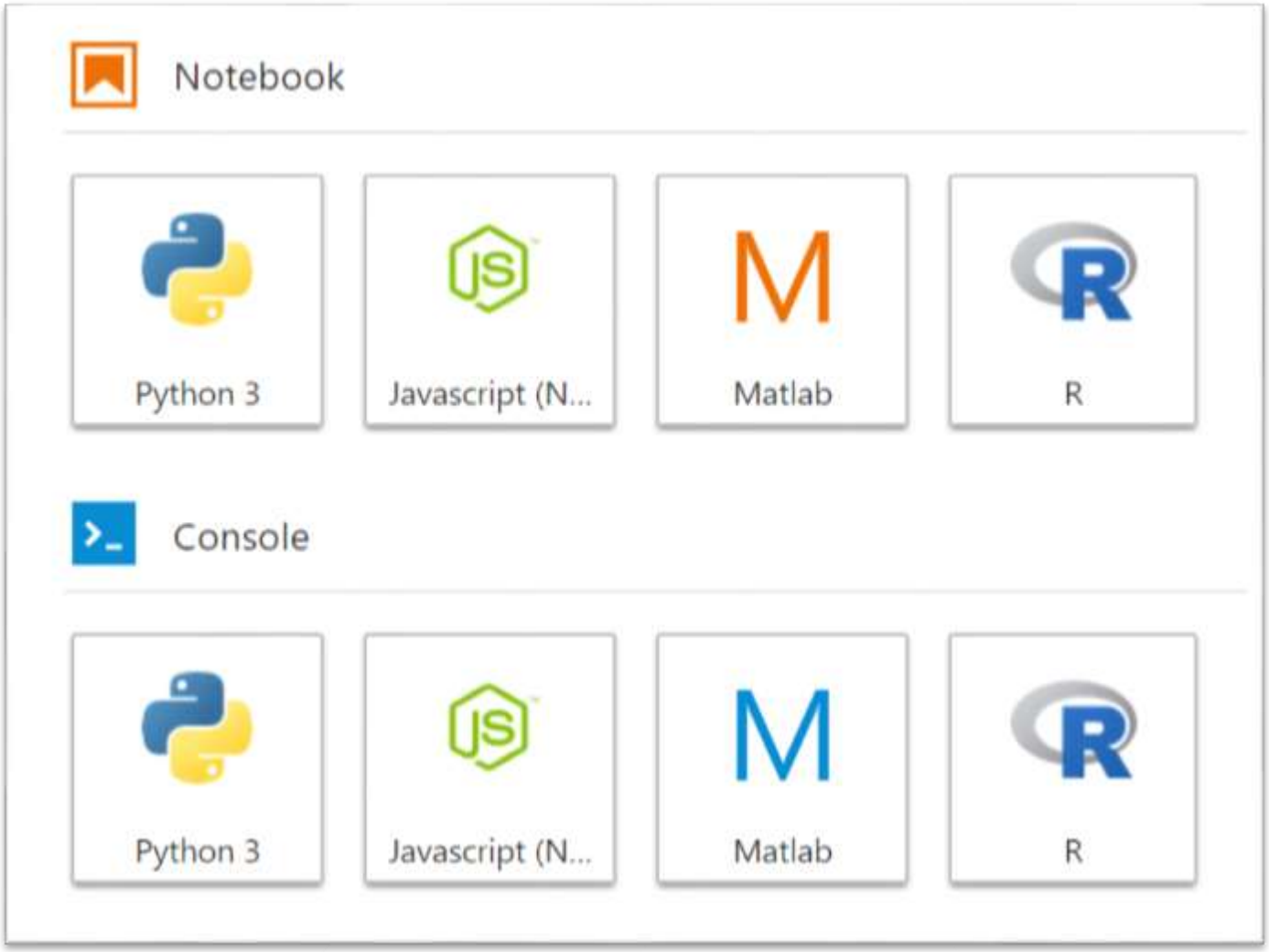
wk11 : Practice : aann-rpt11

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

제출폴더명 : aann-rpt11
- 제출할 파일들 ① AAnn_iot_mongodb_web.png ② AAnn_iot_json.png ③ AAnn_iot_client.png ④ All *.js ⑤ public/All *.html ⑥ public/data/All data (*.csv)

IoT data mining

3. How to use and understand iot data? → Python(or R) in Colab/Jupyter lab



IoT data mining

How to use and understand iot data? → Google Colab

Open in Colab

Pandas: access to the remote json from MongoDB

- The json file is generated on the fly from the express server of Node.js.
- The data stored in MongoDB are saved in the json file.
- The data are composed of three time series; temperature, humidity, and luminosity.

In [0]:
```
import pandas as pd
```

In [0]:
```
# loading json file from MongoDB via web (CORS, port=3030)
url="http://chaos.inje.ac.kr:3030/iot"
df=pd.read_json(url)
print('Large data was retrieved successfully from MongoDB!')
```

In [0]:
```
df.head()
```

A5.9.8 IOT data mining

3.1 How to use and understand iot data? → iot_csv.ipynb, iot_json.ipynb

Redwoods / Arduino

Code | Issues 0 | Pull requests 0 | Projects 0 | Wiki

Branch: master | Arduino / ar-iot / py-pandas /

Redwoods Add files via upload

..

data	Add files via upload
iot_csv.ipynb	Colaboratory를 통해 생성됨
iot_json.ipynb	Colaboratory를 통해 생성됨

A5.9.8 MongoDB management

3.2 Loading data … → iot_json.ipynb

[1]
```
import pandas as pd
```

[2]
```
# loading json file from MongoDB via web (CORS, port=3030)
url="http://chaos.inje.ac.kr:3030/iot"
j1=pd.read_json(url)
```

1. Express 서버에서 MongoDB에 접속한다.
2. 아두이노에서 만들어져 전송되어 MongoDB에 저장되고 있는 센서 데이터를 json 파일로 가져온다.

[3]
```
j1.head()
```

	__v	_id	date	humidity	luminosity	temperature
0	0	5bce24218d1ec32774d781a9	2018-10-23 04:25:21.349	39.7	0	23.2
1	0	5bce242b8d1ec32774d781aa	2018-10-23 04:25:31.594	39.7	0	23.2
2	0	5bce24358d1ec32774d781ab	2018-10-23 04:25:41.855	39.7	0	23.2
3	0	5bce24408d1ec32774d781ac	2018-10-23 04:25:52.100	39.7	0	23.2
4	0	5bce244a8d1ec32774d781ad	2018-10-23 04:26:02.360	39.7	0	23.2

3.3 Make dataframe from json data

Dataframe with date and three sensor values(temperature, humidity, luminosity)

```
[ ]  iot_data = j1[['date', 'temperature', 'humidity', 'luminosity']]
```

Json 객체에서 필요한 항목을 선택해서 pandas의 dataframe을 구성한다.

```
[ ]  iot_data.shape
```

```
(340230, 4)
```

```
[ ]  iot_data.head()
```

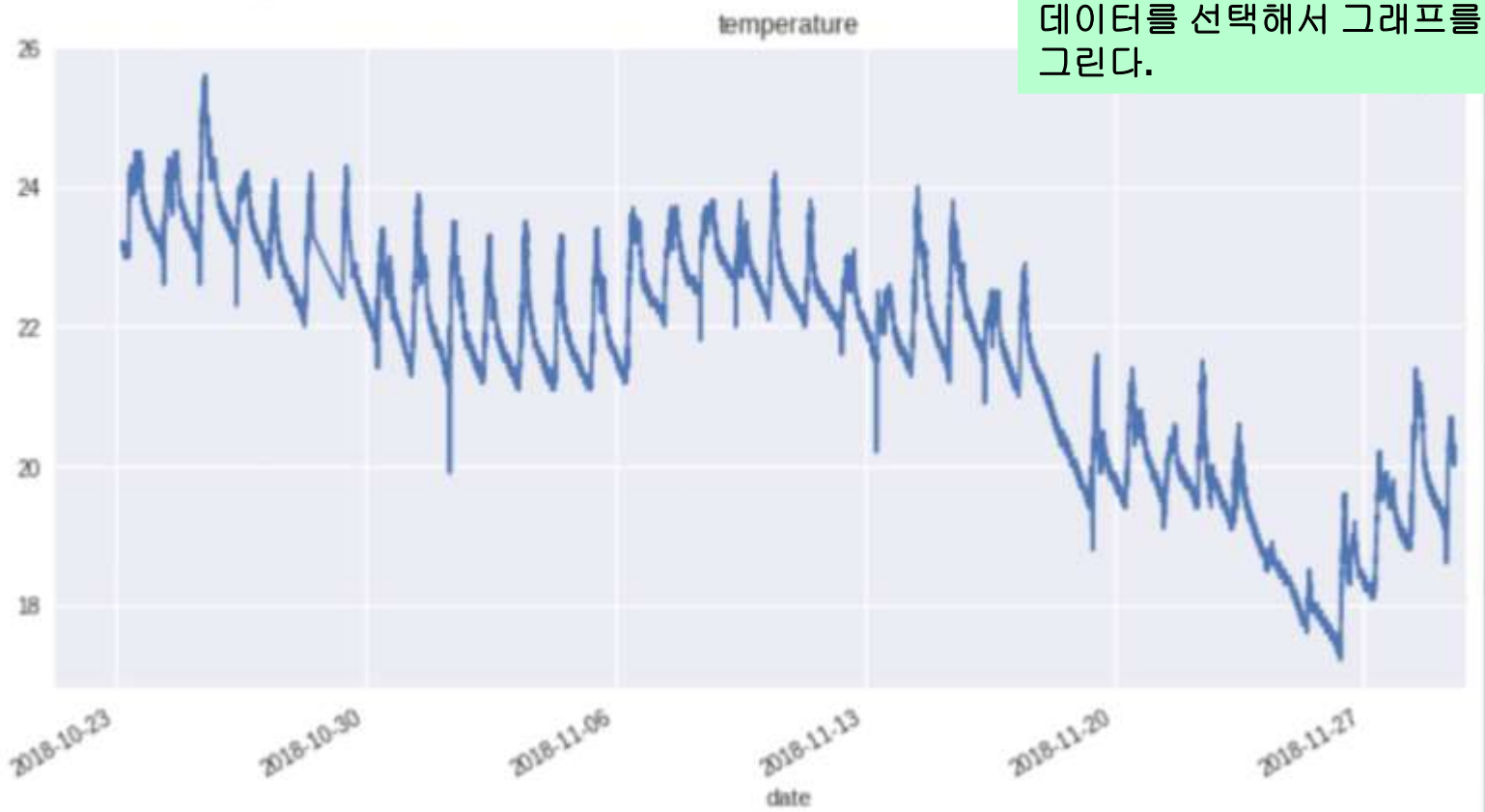
	date	temperature	humidity	luminosity
0	2018-10-23 04:25:21.349	23.2	39.7	0
1	2018-10-23 04:25:31.594	23.2	39.7	0
2	2018-10-23 04:25:41.855	23.2	39.7	0
3	2018-10-23 04:25:52.100	23.2	39.7	0
4	2018-10-23 04:26:02.360	23.2	39.7	0

3.4.1 Plot iot data (time series)

Plot time series of sensor data

```
[ ] iot_data.plot(x='date', y='temperature', figsize=(12,6), title='temperature')
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5b2596e438>
```



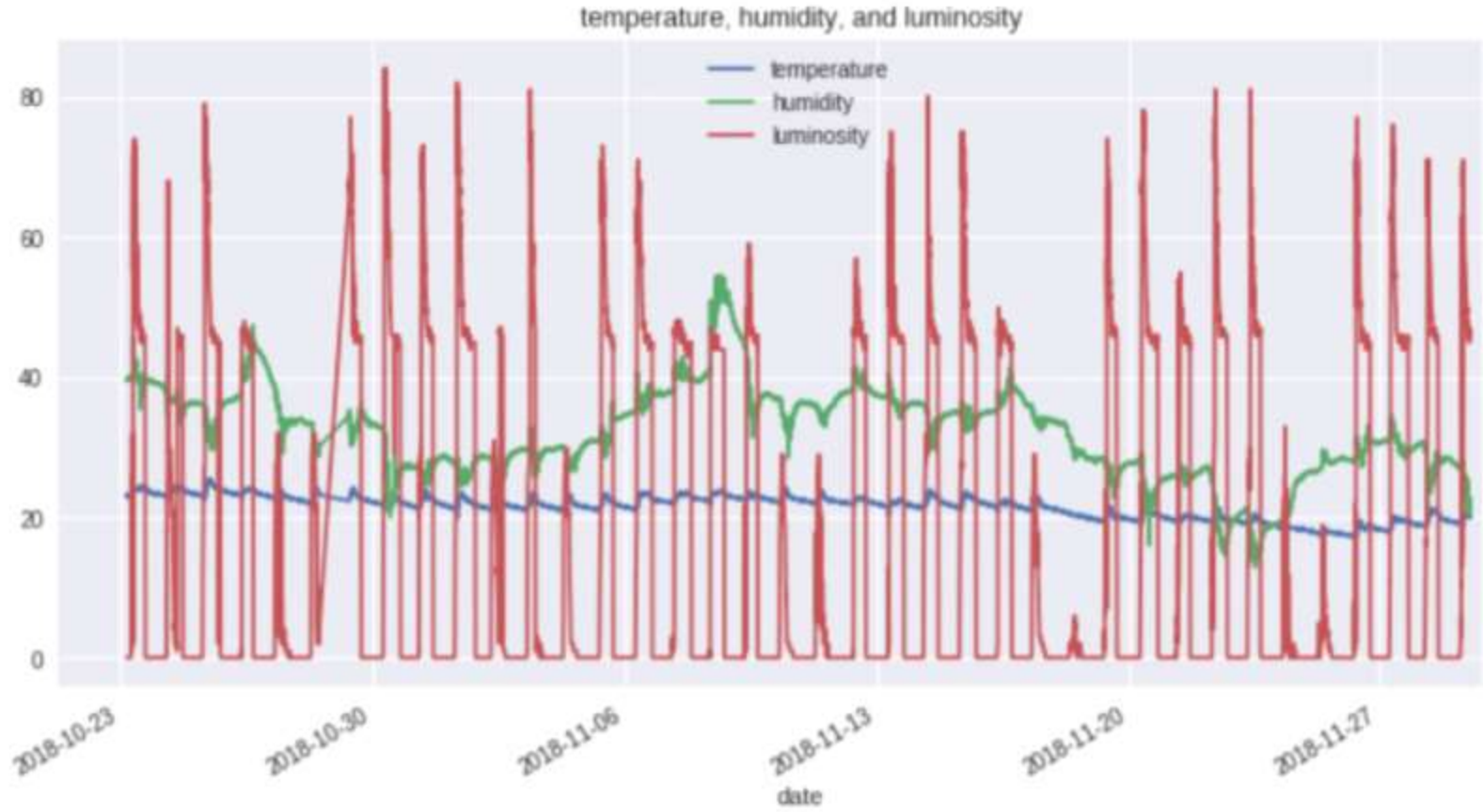
Dataframe에서 시간과 온도 데이터를 선택해서 그래프를 그린다.

3.4.2 Plot iot data (time series)

```
# Plot of ['temperature','humidity','luminosity']
iot_data.plot(x='date', y=['temperature','humidity','luminosity'], figsize=(12,6),
              title='temperature, humidity, and luminosity')
```

```
/usr/local/lib/python3.6/dist-packages/pandas/plotting/_core.py:1716:
  series.name = label
<matplotlib.axes._subplots.AxesSubplot at 0x7f5b28813128>
```

Dataframe에서 시간과 세 개의 센서 데이터를 전부 선택해서 그래프를 그린다.

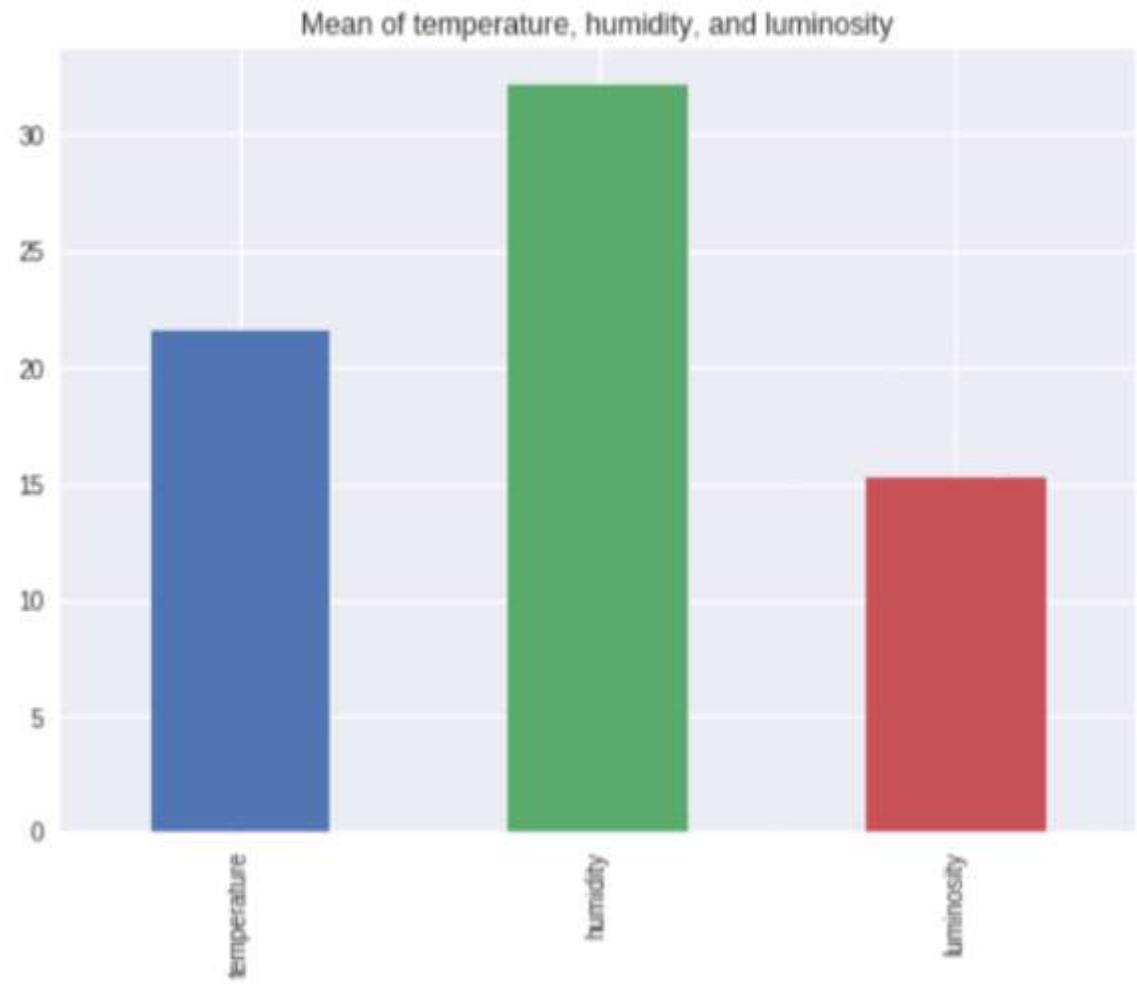


3.5 Plot mean of sensor data

```
iot_data[['temperature','humidity','luminosity']].mean().plot.bar(figsize=(8,6),
                                                                  title="Mean of temperature,
```

Dataframe에서 세 개의 센서 데이터의 평균을 구해서 그래프를 그린다.

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5b297d9470>
```



A5.9.8 IOT data mining

3.6.1 Plot the change of sensor data over various time spans.

Set date as index of timestamp

```
[ ]  iot_data.set_index('date',inplace=True)
```

```
[ ]  iot_data.info() # timestamp index
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 307849 entries, 2018-10-23
Data columns (total 3 columns):
temperature    307849 non-null float64
humidity       307849 non-null float64
luminosity     307849 non-null int64
dtypes: float64(2), int64(1)
memory usage: 9.4 MB
```

```
iot_data.head()
```

date	temperature	humidity	luminosity
2018-10-23 04:25:21.349	23.2	39.7	0
2018-10-23 04:25:31.594	23.2	39.7	0
2018-10-23 04:25:41.855	23.2	39.7	0
2018-10-23 04:25:52.100	23.2	39.7	0
2018-10-23 04:26:02.360	23.2	39.7	0

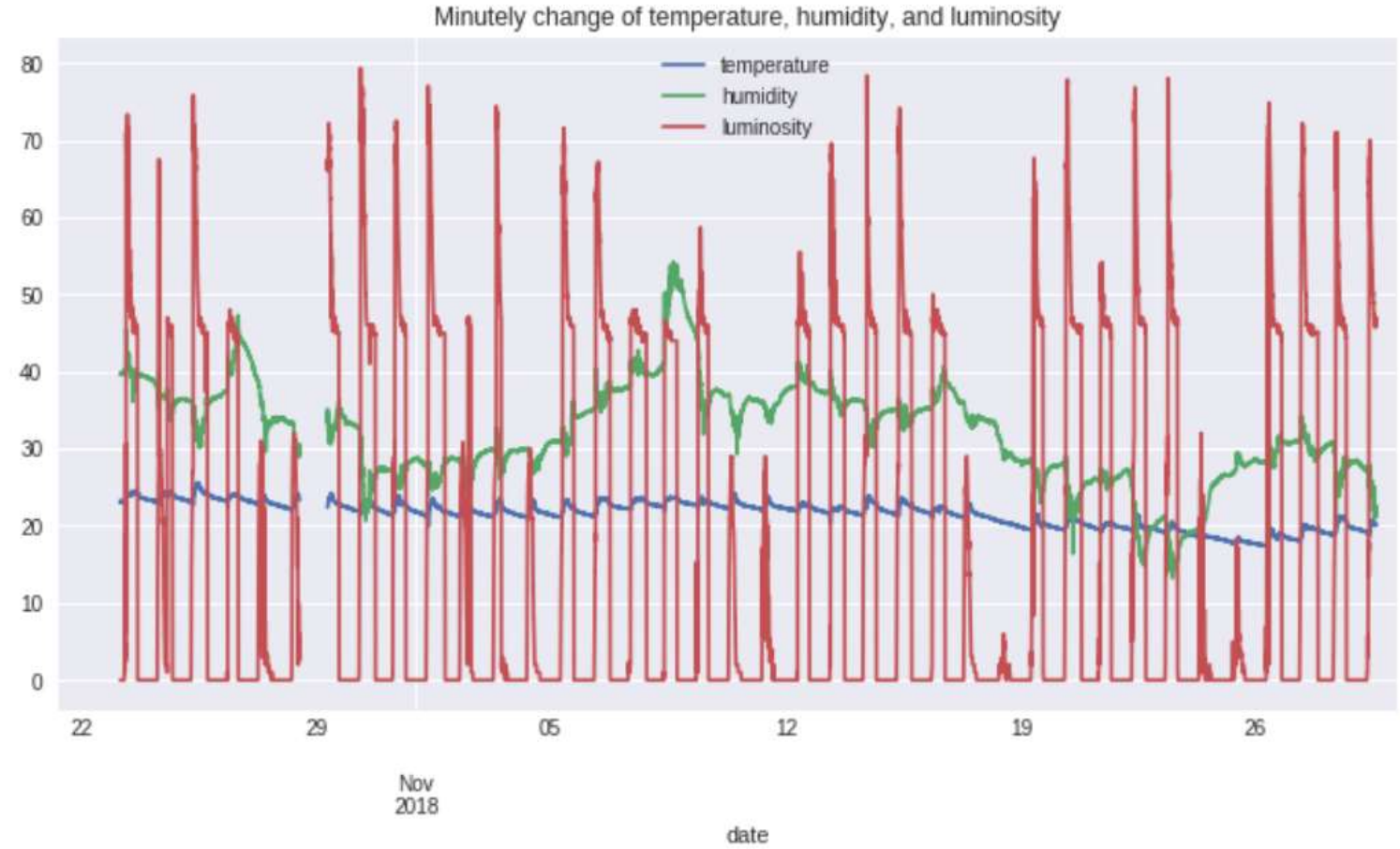
시간(date)을 timestamp 형태의 Index로 변경해서 데이터를 재구성한다.

A5.9.8 IOT data mining

3.6.2 Plot the change of sensor data over various time spans.
1 분당 평균 그래프

```
# Plot mean of the iot data per every minute
iot_data.resample('60S').mean().plot(figsize=(12,6),
                                     title='Minutely change of temperature, humidity, and lumi
```

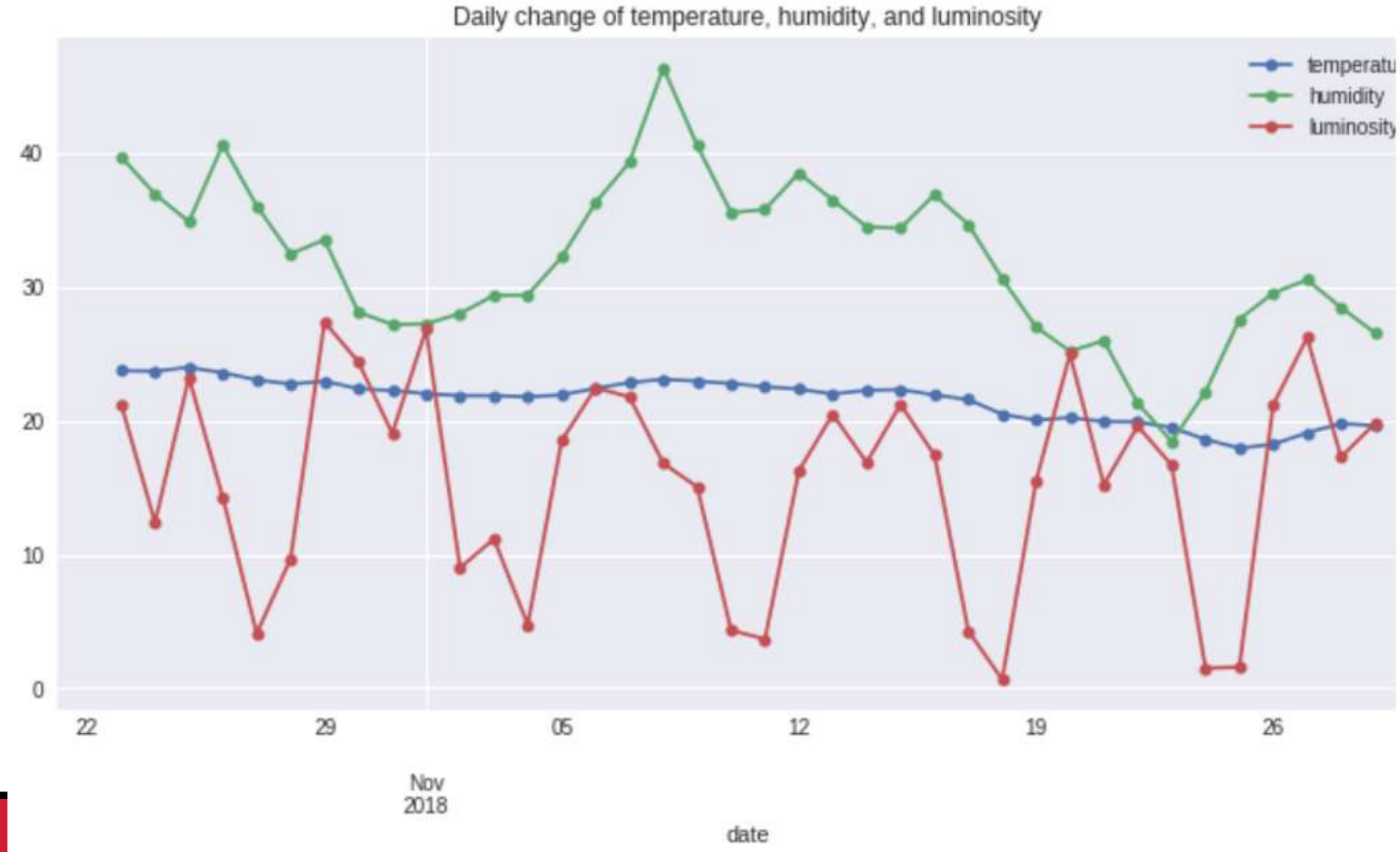
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5b2b57c630>
```



3.6.3 Plot the change of sensor data over various time spans.
1 일당 평균 그래프

```
# Plot mean of the iot data per every day
iot_data.resample('D').mean().plot(kind='line', marker='o', ms=6, figsize=(12,6),
                                   title='Daily change of temperature, humidity, and luminosit
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5b2c7fb7f0>
```

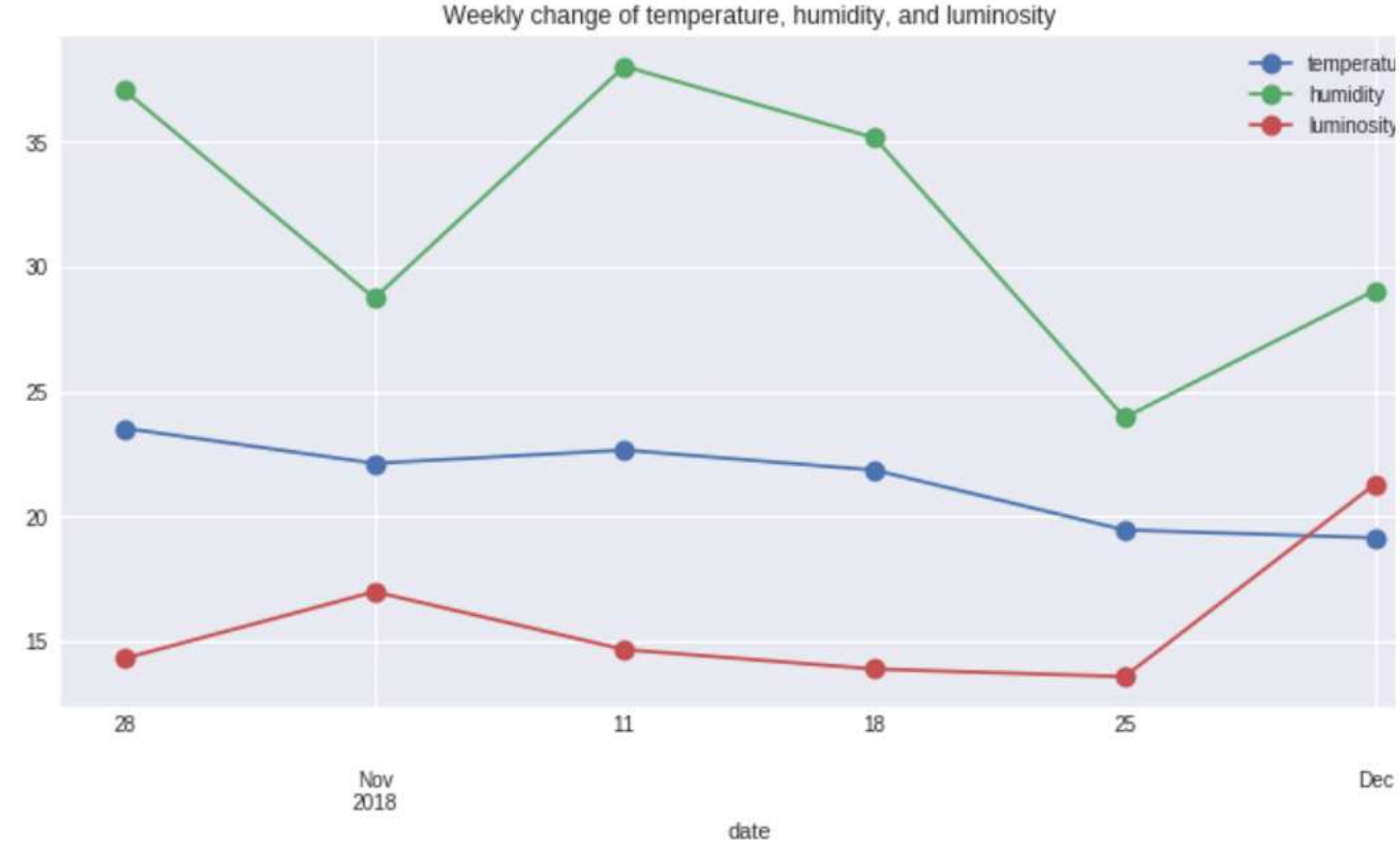


A5.9.8 IOT data mining

3.6.3 Plot the change of sensor data over various time spans.
1 주당 평균 그래프

```
# Plot mean of the iot data per every week
iot_data.resample('W').mean().plot(kind='line', marker='o', ms=10,
                                   figsize=(12,6),
                                   title='Weekly change of temperature, humidity, and luminosi
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f5b2c8f8748>
```



Lecture materials

References & good sites

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

Target of this class

Real-time Weather Station from nano 33 BLE sensors

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