
IoT Inertial Mesuament Unit Monitoring

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Topic

- **Introduction**
- **Object**
- **Scope**
- **Process**
- **Principle**
- **Test**
- **Problem**
- **Summarize**

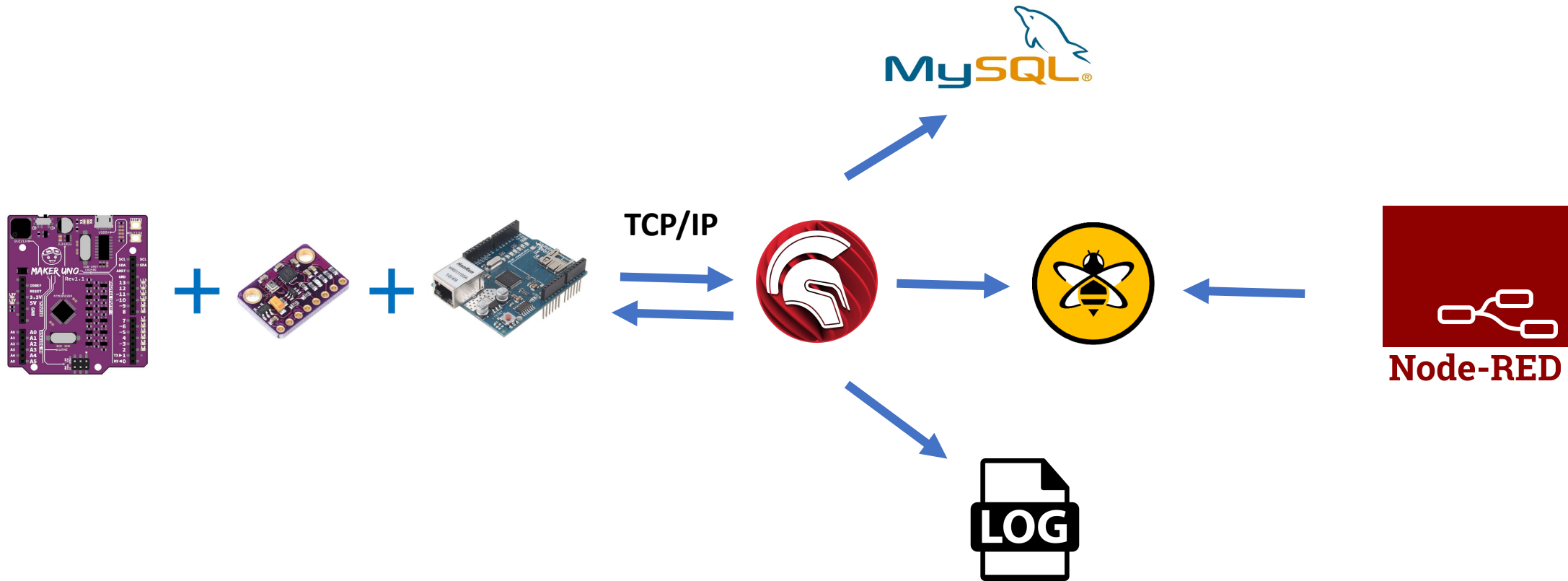
Objective

- For study how to application VCL/FMX using delphi.
- For study how to use delphi connect the controller using TCP/IP.
- For design IMU data monitoring system

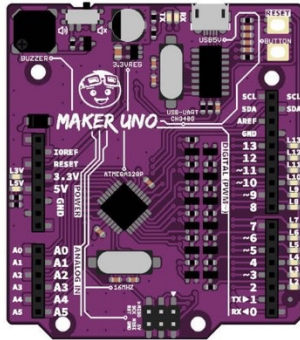
Scope

- **Data monitoring**
- **Transive and resiceve data using TCP/IP**
- **Control 3D opject movment**
- **Loggging data file**
- **Sorted Data in MySQL database**
- **Send data to MQTT**
- **Monitoring on Nod-Red**

IoT Inertial Mesuament Unit Monitoring



Arduino



SMD ATmega328P microcontroller.

USB Programming facilitated by the CH340.

Input voltage: USB 5V, from computer, power bank or standard USB adapter.

500mA (maximum) 3.3V voltage regulator.

0-5V outputs with 3.3V compatible inputs.

14 Digital I/O Pins (6 PWM outputs).

6 Analog Inputs.

ISP 6-pin Header.

32k Flash Memory.

16MHz Clock Speed.

R3 Shield Compatible.

LED array for 5V, 3.3V, TX, RX and all digital pins.

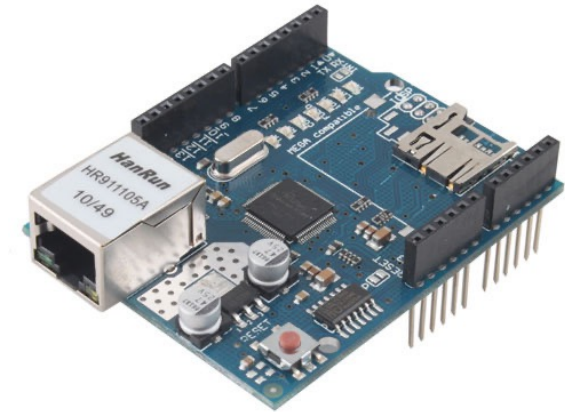
On board programmable push button (pin 2, need to configure as INPUT_PULLUP).

On board piezo buzzer (pin 8).

Utilize USB Micro-B socket.

Arduino Ethernetsheild

Shield	Name	Arduino® Ethernet Shield Rev 2
	SKU	A000024
	Compatibility	UNO, MEGA
Ethernet	Connector	RJ45
	Controller	W5500
	Speed	10/100 Mbps
	Communication	SPI
	Internal memory	32KB
	Maximum sockets	8 individual
	Supported protocols	IPv4, ICMP, TCP, UDP, ARP, IGMP, PPPoE, MQTT
Storage	Micro SD card slot	
Power	Operating voltage	5V
Connectors	TinkerKit	Yes, 6x



GY-91



MPU9250 + BMP280 module

(Three-axis gyroscope + triaxial accelerometer + triaxial magnetic field + pressure)

Module Model: GY-91

Use chip: MPU-9250 + BMP280

Power supply: 3-5v (internal low dropout regulator)

Communication: standard IIC / SPI communications protocol

-Chip 16bit AD converter, 16-bit data output

Gyroscopes range: ± 250 500 1000 2000 ° / s

Acceleration range: ± 2 ± 4 ± 8 ± 16 g

Field range: ± 4800 uT

Pressure range: 300-1100hPa

Arduino I2C Connected IMU

```
1 #include "SPI.h"
2 #include "Ethernet.h"
3 #include <MPU9250_asukiaaa.h>
4 #include <Adafruit_BMP280.h>
5
6 byte mac[] = {0xDE, 0xAD, 0xBE, 0xEF, 0xFE, 0xED};
7 EthernetServer server(80);
8 int v;
9 float voltage;
10
11 int trigPin = 2; //Assign D2 as trigPin
12 int echoPin = 4; //Assign D4 as echoPin
13 long duration;
14 float distance;
15
16 Adafruit_BMP280 bme; // I2C
17 MPU9250_asukiaaa mySensor;
18 float aX, aY, aZ, aSqrt, gX, gY, gZ, mDirection, mX, mY, mZ;
19
20
21 void setup() {
22   Serial.begin(115200); //Set Serial Communication
23   Ethernet.begin(mac); //
24   server.begin(); //Start Arduino as Server role
25   Serial.print("Arduino as Server Role IPaddress: ");
26   Serial.println(Ethernet.localIP());
27
28   while (!Serial);
29
30 #ifdef _ESP32_HAL_I2C_H // For ESP32
31   Wire.begin(SDA_PIN, SCL_PIN);
32   mySensor.setWire(&Wire);
33 #else
34   Wire.begin();
35   mySensor.setWire(&Wire);
36 #endif
37
38   bme.begin();
39   mySensor.beginAccel();
40   mySensor.beginGyro();
41   mySensor.beginMag();
42 }
```

```
44 void loop() {
45   EthernetClient client = server.available(); //Wait connection from TCP/IP
46   if (client) {
47     Serial.println("Hi...New Client");
48     while (client.connected()) {
49       while (client.available()) {
50         char data = client.read();
51         Serial.println(data);
52         switch (data) {
53           case 'a': // data='a'--> Do nothing
54             Serial.print("");
55             client.println(""); //Arduino as Server send data to LabVIEW as Client
56             break;
57           case 'b': // data='b' Read voltage from A0 and send back to LabVIEW
58             if (mySensor.accelUpdate() == 0) {
59               aX = mySensor.accelX();
60               aY = mySensor.accelY();
61               aZ = mySensor.accelZ();
62               aSqrt = mySensor.accelSqrt();
63               Serial.print(String(aX)); Serial.print(",");
64               Serial.print(String(aY)); Serial.print(",");
65               Serial.print(String(aZ)); Serial.print(",");
66               Serial.print(String(aSqrt)); Serial.print(",");
67               //-----//
68               client.print(String(aX)); client.print(",");
69               client.print(String(aY)); client.print(",");
70               client.print(String(aZ)); client.print(",");
71               client.print(String(aSqrt)); client.print(",");
72             }

```

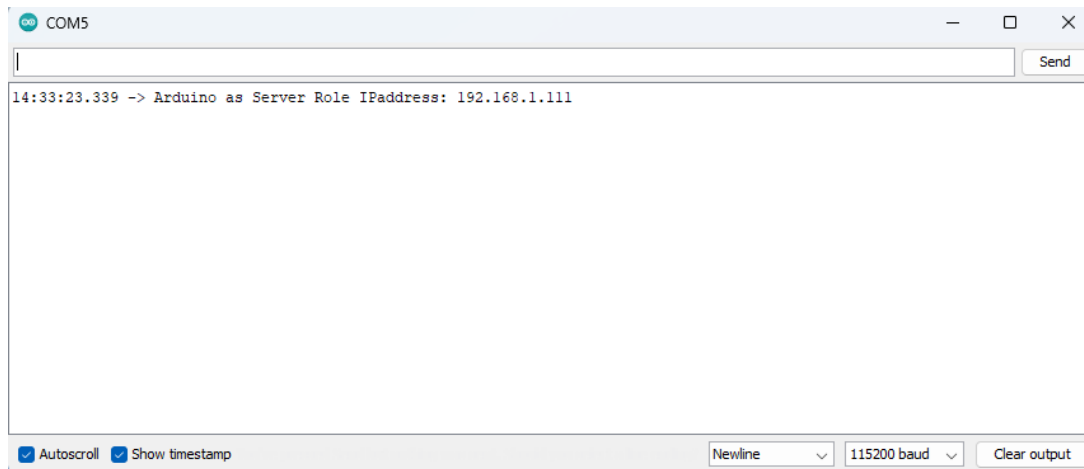
Arduino I2C Connected IMU

```
74 if (mySensor.gyroUpdate() == 0) {
75   gX = mySensor.gyroX();
76   gY = mySensor.gyroY();
77   gZ = mySensor.gyroZ();
78   client.print(String(gX)); client.print(",");
79   client.print(String(gY)); client.print(",");
80   client.print(String(gZ)); client.print(",");
81   //-----//
82   Serial.print(String(gX)); Serial.print(",");
83   Serial.print(String(gY)); Serial.print(",");
84   Serial.print(String(gZ)); Serial.print(",");
85 }
86
87 if (mySensor.magUpdate() == 0) {
88   mX = mySensor.magX();
89   mY = mySensor.magY();
90   mZ = mySensor.magZ();
91   mDirection = mySensor.magHorizDirection();
92   Serial.print(String(mX)); Serial.print(",");
93   Serial.print(String(mY)); Serial.print(",");
94   Serial.print(String(mZ)); Serial.print(",");
95   Serial.print(String(mDirection)); Serial.print(",");
96   //-----//
97   client.print(String(mX)); client.print(",");
98   client.print(String(mY)); client.print(",");
99   client.print(String(mZ)); client.print(",");
100   client.print(String(mDirection)); client.print(",");
101 }
```

```
102
103 // Serial.print("\tTemperature(*C): ");
104 Serial.print(bme.readTemperature()); Serial.print(",");
105 //-----//
106 client.print(bme.readTemperature()); client.print(",");
107
108 // Serial.print("\tPressure(Inches(Hg)): ");
109 Serial.print(bme.readPressure() / 3377); Serial.print(",");
110 //-----//
111 client.print(bme.readPressure() / 3377); client.print(",");
112
113
114 // Serial.print("\tApproxAltitude(m): ");
115 Serial.print(bme.readAltitude(1013.25)); // this should be adjusted to your local forcase
116 //-----//
117 client.print(bme.readAltitude(1013.25)); // this should be adjusted to your local forcase
118
119 Serial.println(""); // Add an empty line
120 //-----//
121 client.println("");
122 break;
123 }
124 }
125 }
126 }
127 }
```

Arduino I2C Connected IMU

Arduino IP

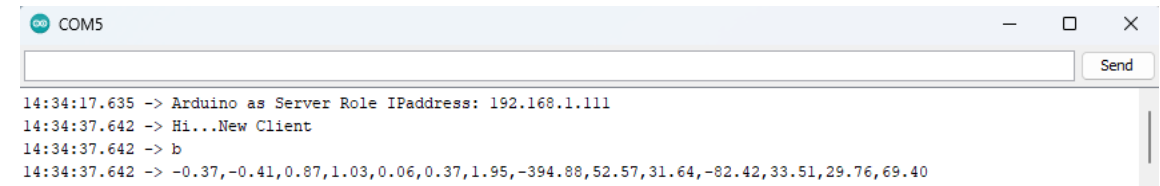


COM5

14:33:23.339 -> Arduino as Server Role IPAddress: 192.168.1.111

Autoscroll Show timestamp Newline 115200 baud Clear output

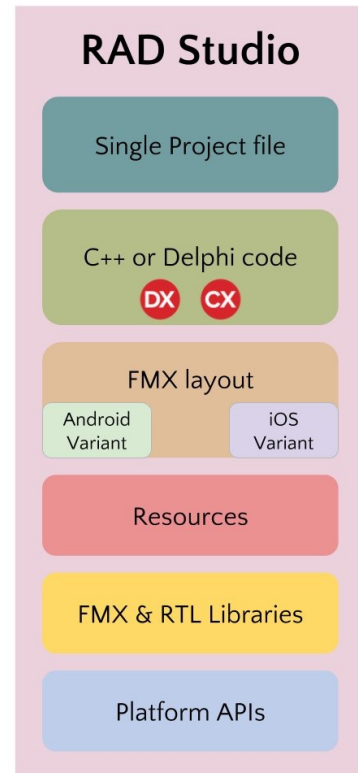
Delphi Connected



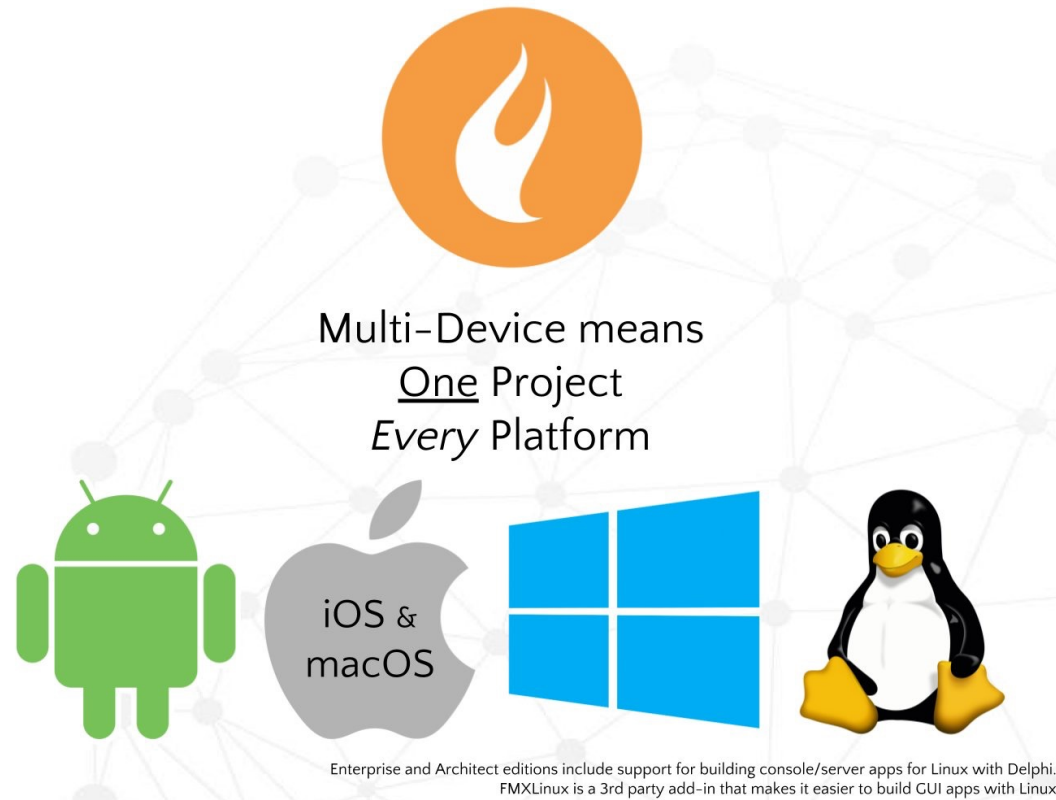
COM5

14:34:17.635 -> Arduino as Server Role IPAddress: 192.168.1.111
14:34:37.642 -> Hi...New Client
14:34:37.642 -> b
14:34:37.642 -> -0.37,-0.41,0.87,1.03,0.06,0.37,1.95,-394.88,52.57,31.64,-82.42,33.51,29.76,69.40

Implementation On FMX Application

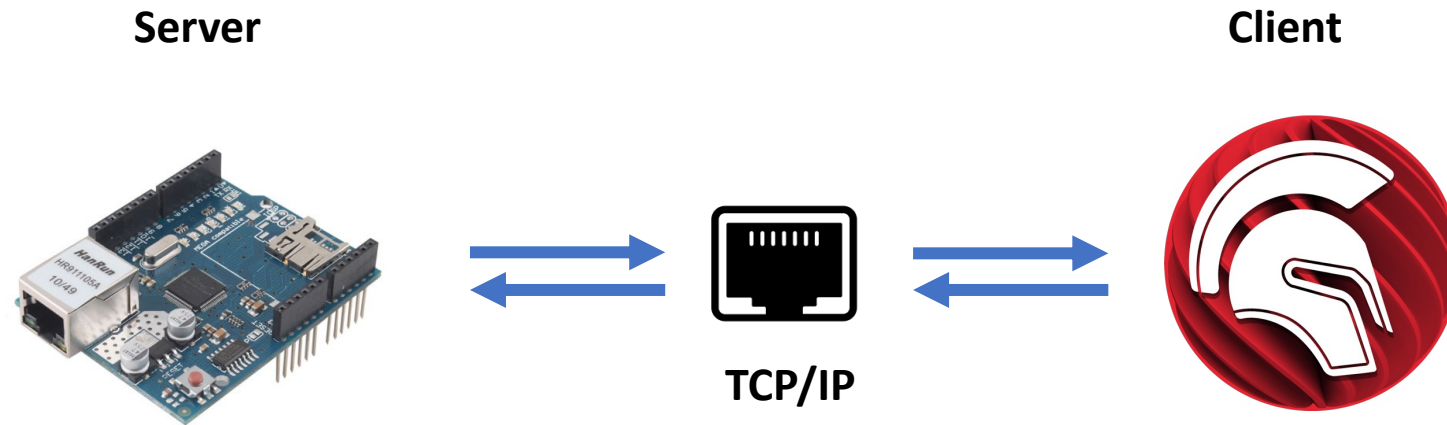


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Posted to: delphi.org/?p=3237

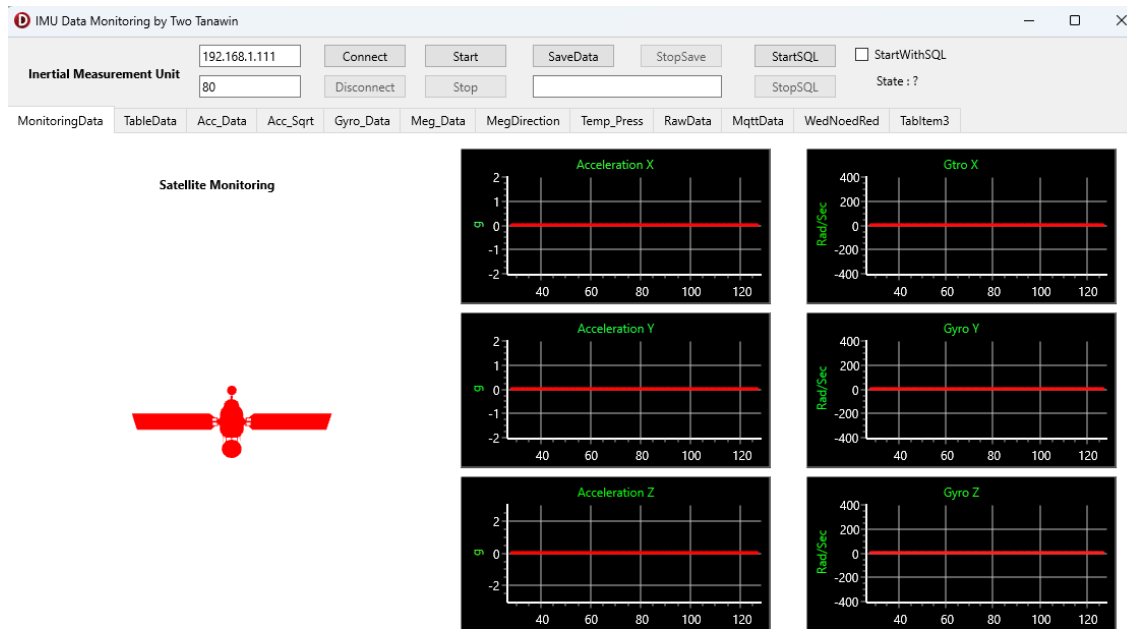


Enterprise and Architect editions include support for building console/server apps for Linux with Delphi.
FMXLinux is a 3rd party add-in that makes it easier to build GUI apps with Linux

Delphi Conect Arduino Using TCP/IP

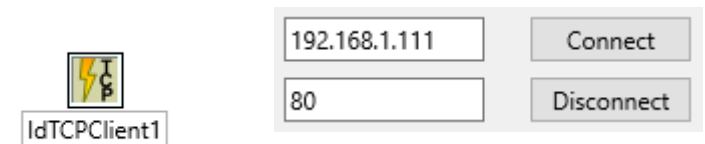


Delphi TCP/IP Connected Controller

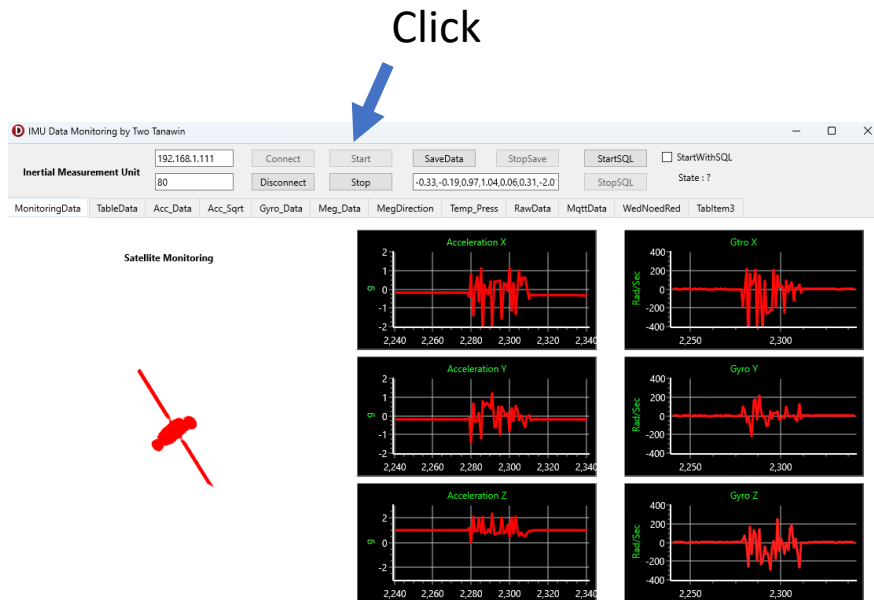


```
procedure TForm1.ConnectClick(Sender: TObject);  
begin  
    IdTCPClient1.Connect;  
end;
```

```
910 procedure TForm1.DisconnectClick(Sender: TObject);  
begin  
    IdTCPClient1.Disconnect;  
end;
```



Delphi Start System



```

• procedure TForm1.StartClick(Sender: TObject);
• begin
•   if IdTCPClient1.Connected=False then
•     begin
•       ShowMessage('Please Connect The Sever');
•     end
•   else
•     begin
680       Start.Enabled:=False;
•       Stop.Enabled:=True;
•       StartClient;
•       Timer1.Enabled:=True;
•       if CheckBox1.IsChecked then
•         begin
•           ThreadSqlStart;
•         end
•       else
•         begin
690           EndThreadSql;
•         end;
•     end;
• end;

```

```

• procedure TForm1.StopClick(Sender: TObject);
560 • begin
•   StopClient;
•   EndThreadSQL;
•   Timer1.Enabled:=False;
•   Start.Enabled:=True;
•   Stop.Enabled:=False;
•   if CheckBox1.IsChecked then
•     begin
•       EndThreadSQL;
570 •   end;
• end;

```

Delphi Extrax Data

```

type
TClientRead = class(TThread)
private
protected
40  procedure Execute; override;
end;

procedure TForm1.StartClient;
begin
  if MyCleint = nil then
    MyCleint := TClientRead.create(false);
end;

```

```

procedure TClientRead.Execute;
var
1180  Sl:TStringList;
    Data:String;
begin
  inherited;
  try
    repeat
      Application.ProcessMessages;
      Form1.IdTCPClient1.Socket.WriteLine('b'+#13#10);
      Form1.Edit3.Text:=Form1.IdTCPClient1.Socket.ReadLn;
      Form1.AddLog(Form1.Edit3.text);
1190  Sl:=TStringList.Create;
      Sl.CommaText:=Form1.Edit3.Text; //Extrax string
      if Sl.Count = 14 then
      begin
        Form1.accData.aX:=Sl[0];
        Form1.accData.aY:=Sl[1];
        Form1.accData.aZ:=Sl[2];
        Form1.accData.rq:=Sl[3];
        Form1.gyroData.gyroX:=Sl[4];
        Form1.gyroData.gyroY:=Sl[5];
        Form1.gyroData.gyroZ:=Sl[6];
        Form1.magData.magX:=Sl[7];
        Form1.magData.magY:=Sl[8];
        Form1.magData.magZ:=Sl[9];
        Form1.magData.magH:=Sl[10];
        Form1.tempData.TempX:=Sl[11];
        Form1.tempData.PressX:=Sl[12];
        lastData:=Sl[13];
      end;
      if Assigned(Sl) then
1210  FreeAndNil(Sl);
      Form1.recMyData;
      until Terminated;
    except
      ShowMessage('Please Connecte The Sever!');
    end;
  end;
end;

```

```

Type
tAcc = record
  X:Single;
  Y:Single;
  Z:Single;
end;

type
TaccData = record
110  aX:String;
  aY:String;
  aZ:String;
  rq:String;
end;

type
TgyroData = record
  gyroX:String;
  gyroY:String;
120  gyroZ:String;
end;

type
TmagData = record
  magX:String;
  magY:String;
  magZ:String;
  magH:String;
end;

type
TtempData = record
130  TempX:String;
  PressX:String;
end;

```


Delphi Plot Graph

```
procedure TMyPlot.Execute;  
begin  
    inherited;  
    repeat  
        Application.ProcessMessages;  
        Sleep(100);  
1290    Synchronize(Form1.SumPlot);  
    until Terminated;  
end;
```

```
procedure TForm1.SumPlot; // All Plot Data  
begin  
    PlotAccD();  
    PlotGyroD();  
    PlotNorm();  
    PlotMag();  
    PlotMagH();  
    Teamp_Press();  
610 end;
```

```
procedure TForm1.PlotAcc; //Plot Acc  
begin  
    PlotLineGraph(AccX, StrToFloat(accData.aX));  
    PlotLineGraph(AccY, StrToFloat(accData.aY));  
    PlotLineGraph(AccZ, StrToFloat(accData.aZ));  
end;
```

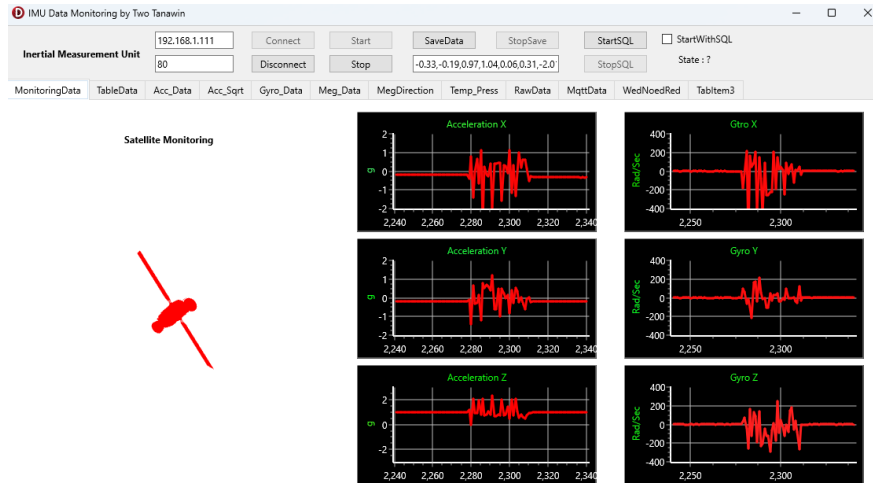
```
procedure TForm1.PlotAccD; //Plot Acc  
1040 begin  
    PlotLineGraph(AccXD, StrToFloat(accData.aX));  
    PlotLineGraph(AccYD, StrToFloat(accData.aY));  
    PlotLineGraph(AccZD, StrToFloat(accData.aZ));  
end;
```

```
procedure TForm1.PlotGyro; //Plot Gyro  
begin  
    PlotLineGraph(GyroX, StrToFloat(gyroData.gyroX));  
    PlotLineGraph(GyroY, StrToFloat(gyroData.gyroY));  
1050 PlotLineGraph(GyroZ, StrToFloat(gyroData.gyroZ));  
end;
```

```
procedure TForm1.PlotGyroD; //Plot Gyro  
begin  
    PlotLineGraph(GyroXD, StrToFloat(gyroData.gyroX));  
    PlotLineGraph(GyroYD, StrToFloat(gyroData.gyroY));  
    PlotLineGraph(GyroZD, StrToFloat(gyroData.gyroZ));  
end;
```

```
1060 procedure TForm1.PlotLineGraph(Graph: TLineSeries; Data: Real);  
var  
    tmpX: Double;  
begin  
    with Graph do  
    begin  
        if XValues.Count < 100 then  
        begin  
            Add(Data);  
        end  
1070     else  
        begin  
            tmpX := XValues[1] - XValues[0];  
            Delete(0);  
            AddXY(XValues.Last + tmpX, Data, '', clTeeColor);  
        end;  
    end;  
end;
```

Graph In FMX Application



```

60 type
* Tmy3d = class(TThread)
* private
* procedure callSig();
* protected
* procedure Execute; override;
* end;

* procedure Tmy3d.callSig;
1330 var
* Sl:TStringList;
* Data:String;
* i:Integer;
* begin
* Application.ProcessMessages;
* Form1.Model3D1.Position.X := StrToFloat(Form1.accData.aX);
* Form1.Model3D1.Position.Y := StrToFloat(Form1.accData.aY);
* Form1.Model3D1.Position.Z := StrToFloat(Form1.accData.aZ);
* Form1.Model3D1.RotationAngle.X := StrToFloat(Form1.gyroData.gyroX);
1340 Form1.Model3D1.RotationAngle.Y := StrToFloat(Form1.gyroData.gyroY);
* Form1.Model3D1.RotationAngle.Z := StrToFloat(Form1.gyroData.gyroZ);
* end;

* procedure Tmy3d.Execute;
* begin
* inherited;
* repeat
* Application.ProcessMessages;
1350 Sleep(100);
* Synchronize(callSig);
* until Terminated;
* end;
    
```

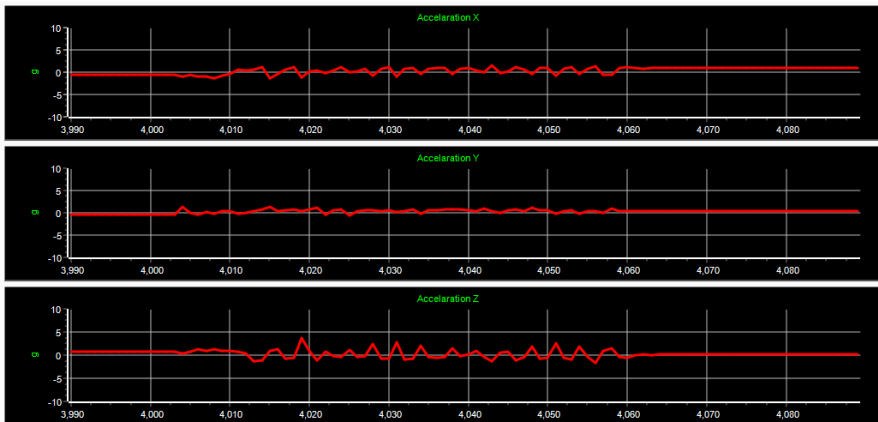
```

* type
* TModel = class(TThread)
* private
* protected
* procedure Execute; override;
* end;

* procedure TModel.Execute;
* begin
* inherited;
* repeat
* Application.ProcessMessages;
* Form1.PlotAcc();
* Form1.PlotGyro();
* Sleep(100);
* until Terminated;
1230 end;
    
```

Graph In FMX Application

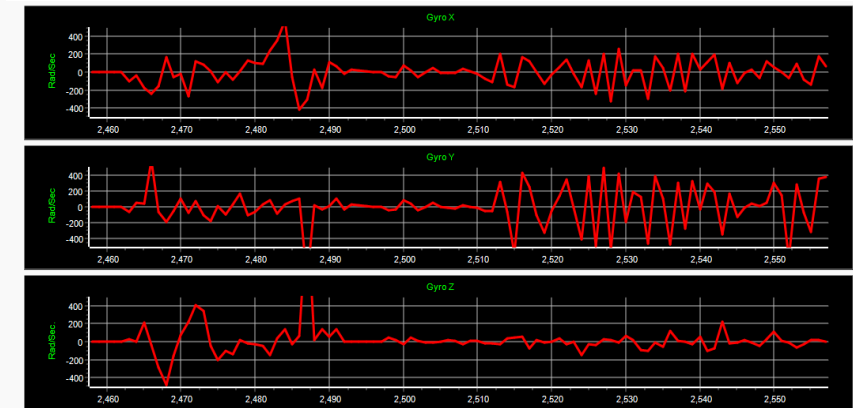
Acceleration XYZ



Acceleration Norm



Gyro XYZ

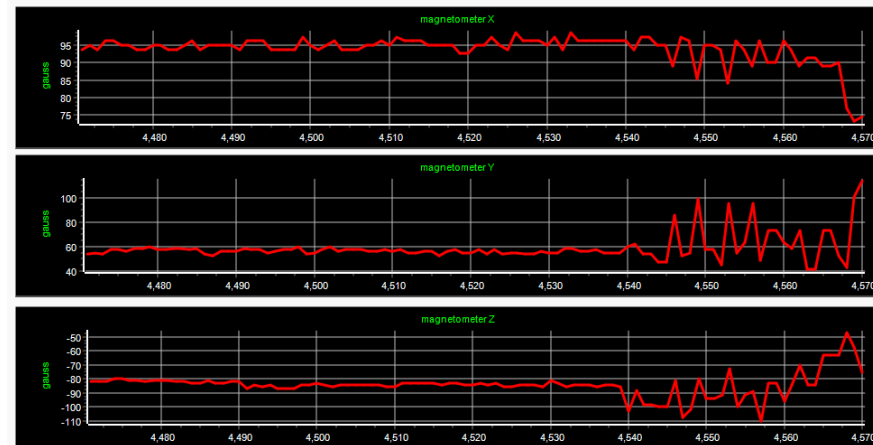


Graph In FMX Application

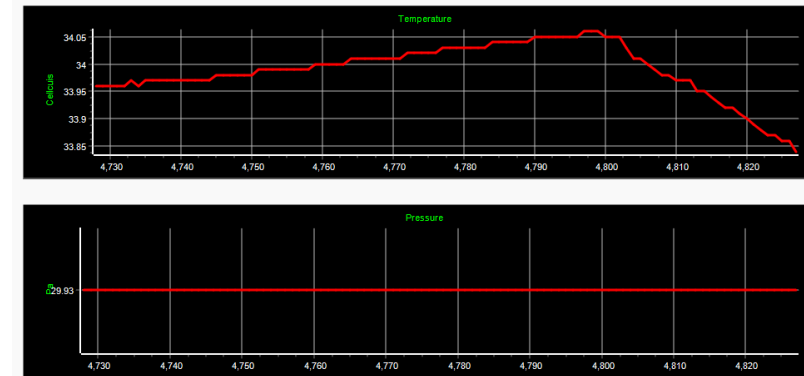
Magnetrometer Horizontal



Magnetrometer XYZ



Temp & Pressure



Delphi Store Data Using MySQL



IMU Data Monitoring by Two Tanawin

Inertial Measurement Unit

192.168.1.111

Connect

Start

SaveData

StopSave

StartSQL

☐ StartWithSQL

80

Disconnect

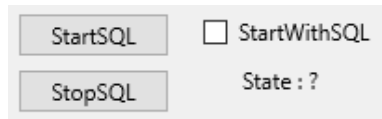
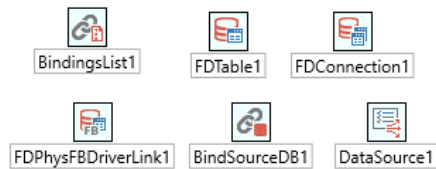
Stop

StopSQL

State : ?

MonitoringData	TableData	Acc_Data	Acc_Sqrt	Gyro_Data	Meg_Data	MegDirection	Temp_Press	RawData	MqttData	WedNoedRed	TabItem3		
DateTime	acceleratio...	acceleratio...	acceleratio...	accelerationNor...	GyroX	GyroY	GyroZ	MagnetoX	MagnetoY	MagnetoZ	magHorizDirecti...	Temperatu...	Pre
11/21/2022 10:24:0...	-0.31	-0.1	0.99	1.04	0.31	0.79	1.83	-86.53	6.11	-139.45	-85.96	31.22	▲
11/21/2022 10:24:0...	-0.31	-0.09	0.99	1.04	-0.85	0.06	3.42	-84.09	1.22	-141.8	-89.17	31.24	
11/21/2022 10:24:1...	-0.3	-0.1	0.99	1.04	0.73	1.28	0.67	-86.53	2.45	-138.28	-88.38	31.25	
11/21/2022 10:24:4...	0	0	0	0	0	0	0	0	0	0	0	0	
11/21/2022 10:24:5...	-0.31	-0.1	0.99	1.04	-0.98	-1.04	3.05	-85.31	6.11	-138.28	-85.9	31.23	
11/21/2022 10:25:0...	-0.3	-0.1	0.99	1.04	1.71	1.89	-0.37	-85.31	4.89	-139.45	-86.72	31.23	
11/21/2022 10:25:1...	-0.3	-0.1	0.98	1.03	-0.67	0.73	2.87	-85.31	3.67	-138.28	-87.54	31.25	
11/21/2022 10:25:3...	-0.31	-0.1	0.98	1.04	0.18	0.18	1.83	-85.31	2.45	-141.8	-88.36	31.25	
11/21/2022 10:25:4...	-0.31	-0.1	0.98	1.04	3.36	3.23	-0.37	-85.31	3.67	-139.45	-87.54	31.26	
11/21/2022 10:25:4...	-0.31	-0.1	0.98	1.03	-1.1	-0.79	3.48	-85.31	4.89	-140.63	-86.72	31.25	
11/21/2022 10:25:5...	-0.31	-0.1	0.98	1.03	-1.1	-0.79	3.48	-85.31	4.89	-140.63	-86.72	31.25	
11/21/2022 10:25:5...	-0.31	-0.1	0.98	1.03	-1.1	-0.79	3.48	-85.31	4.89	-140.63	-86.72	31.25	
11/21/2022 10:26:3...	-0.31	-0.09	0.98	1.03	2.99	3.72	0.37	-86.53	4.89	-139.45	-86.77	31.24	
11/21/2022 10:26:4...	-0.31	-0.09	0.99	1.04	0.61	1.46	2.2	-84.09	3.67	-141.8	-87.5	31.25	
11/21/2022 10:27:5...	-0.3	-0.1	0.98	1.03	-0.61	0	1.53	-87.75	2.45	-141.8	-88.4	31.25	
11/21/2022 10:32:5...	-0.24	-0.17	0.99	1.04	4.03	5.07	-2.26	-88.97	12.23	-133.59	-82.18	31.29	
11/21/2022 10:33:0...	-0.24	-0.18	1	1.04	-0.31	0.06	3.05	-88.97	11	-133.59	-82.95	31.3	
11/21/2022 11:29:4...	-0.08	-0.22	0.91	0.94	5.98	33.14	13.79	-78	18.34	-145.31	-76.77	32.64	
11/21/2022 11:29:5...	0.36	-0.64	0.7	1.01	-2.32	-6.53	0.73	-71.91	14.67	-86.72	-78.47	32.58	
11/21/2022 11:29:5...	-0.42	-0.29	0.91	1.04	0.92	1.28	0.98	-91.41	-7.34	-130.08	-94.59	32.54	▼

Delphi Record Data Using MySQL



```

1 procedure TForm1.StartSQLClick(Sender: TObject);
2 begin
3   if Start.Enabled=True then
4   begin
5     ShowMessage('Please Enable Start');
550 end
6   else
7   begin
8     ThreadSqlStart;
9     StartSQL.Enabled:=False;
10    StopSQL.Enabled:=True;
11    end;
12  end;
13
14  procedure TForm1.StopClick(Sender: TObject);
15  begin
16    StopClient;
17    EndThreadSQL;
18    Timer1.Enabled:=False;
19    Start.Enabled:=True;
20    Stop.Enabled:=False;
21    if CheckBox1.IsChecked then
22    begin
23      EndThreadSQL;
24    end;
25  end;
26  end;
27
28  570

```

```

50 type
51   TMyThreadSQL = class(TThread)
52   private
53     LastData:String;
54   procedure DataToSQL(aX,aY,aZ,aN,gR,gP,gY,mgX,mgY,mgZ,mgH,temp,press,Alti:Single);
55   procedure ShowDataSQL();
56   protected
57     procedure Execute; override;
58   end;

```

```

1260 procedure TMyThreadSQL.Execute;
1261 begin
1262   inherited;
1263   inherited;
1264   Form1.SQLStat.Text:='SQL is Start';
1265   lastData:='0';
1266   repeat
1267     Application.ProcessMessages;
1268     Synchronize(ShowDataSQL);
1269     Sleep(5000);
1270   until Terminated;
1271 end;
1272
1273 procedure TMyThreadSQL.ShowDataSQL;
1274 begin
1275   DataToSQL(StrToFloat(Form1.accData.aX),StrToFloat(Form1.accData.aY),StrToFloat(Form1.accData.aZ),StrToFloat(Form1.accData.rq),
1276   StrToFloat(Form1.gyroData.gyroX),StrToFloat(Form1.gyroData.gyroY),StrToFloat(Form1.gyroData.gyroZ),
1277   StrToFloat(Form1.magData.magX),StrToFloat(Form1.magData.magY),StrToFloat(Form1.magData.magZ),StrToFloat(Form1.magData.magH),
1278   StrToFloat(Form1.tempData.TempX),StrToFloat(Form1.tempData.PressX),StrToFloat(lastData));
1279 end;
1280

```

MySQL Database Result

IMU Data Monitoring by Two Tanawin

Inertial Measurement Unit

192.168.1.111

Connect

Start

SaveData

StopSave

StartSQL

☐ StartWithSQL

80

Disconnect

Stop

StopSQL

State : ?

MonitoringData	TableData	Acc_Data	Acc_Sqrt	Gyro_Data	Meg_Data	MegDirection	Temp_Press	RawData	MqttData	WedNoedRed	TabItem3		
DateTime	acceleratio...	acceleratio...	acceleratio...	accelerationNor...	GyroX	GyroY	GyroZ	MagnetoX	MagnetoY	MagnetoZ	magHorizDirecti...	Temperatu...	Pre
11/21/2022 10:24:0...	-0.31	-0.1	0.99	1.04	0.31	0.79	1.83	-86.53	6.11	-139.45	-85.96	31.22	^
11/21/2022 10:24:0...	-0.31	-0.09	0.99	1.04	-0.85	0.06	3.42	-84.09	1.22	-141.8	-89.17	31.24	
11/21/2022 10:24:1...	-0.3	-0.1	0.99	1.04	0.73	1.28	0.67	-86.53	2.45	-138.28	-88.38	31.25	
11/21/2022 10:24:4...	0	0	0	0	0	0	0	0	0	0	0	0	
11/21/2022 10:24:5...	-0.31	-0.1	0.99	1.04	-0.98	-1.04	3.05	-85.31	6.11	-138.28	-85.9	31.23	
11/21/2022 10:25:0...	-0.3	-0.1	0.99	1.04	1.71	1.89	-0.37	-85.31	4.89	-139.45	-86.72	31.23	
11/21/2022 10:25:1...	-0.3	-0.1	0.98	1.03	-0.67	0.73	2.87	-85.31	3.67	-138.28	-87.54	31.25	
11/21/2022 10:25:3...	-0.31	-0.1	0.98	1.04	0.18	0.18	1.83	-85.31	2.45	-141.8	-88.36	31.25	
11/21/2022 10:25:4...	-0.31	-0.1	0.98	1.04	3.36	3.23	-0.37	-85.31	3.67	-139.45	-87.54	31.26	
11/21/2022 10:25:4...	-0.31	-0.1	0.98	1.03	-1.1	-0.79	3.48	-85.31	4.89	-140.63	-86.72	31.25	
11/21/2022 10:25:5...	-0.31	-0.1	0.98	1.03	-1.1	-0.79	3.48	-85.31	4.89	-140.63	-86.72	31.25	
11/21/2022 10:25:5...	-0.31	-0.1	0.98	1.03	-1.1	-0.79	3.48	-85.31	4.89	-140.63	-86.72	31.25	
11/21/2022 10:26:3...	-0.31	-0.09	0.98	1.03	2.99	3.72	0.37	-86.53	4.89	-139.45	-86.77	31.24	
11/21/2022 10:26:4...	-0.31	-0.09	0.99	1.04	0.61	1.46	2.2	-84.09	3.67	-141.8	-87.5	31.25	
11/21/2022 10:27:5...	-0.3	-0.1	0.98	1.03	-0.61	0	1.53	-87.75	2.45	-141.8	-88.4	31.25	
11/21/2022 10:32:5...	-0.24	-0.17	0.99	1.04	4.03	5.07	-2.26	-88.97	12.23	-133.59	-82.18	31.29	
11/21/2022 10:33:0...	-0.24	-0.18	1	1.04	-0.31	0.06	3.05	-88.97	11	-133.59	-82.95	31.3	
11/21/2022 11:29:4...	-0.08	-0.22	0.91	0.94	5.98	33.14	13.79	-78	18.34	-145.31	-76.77	32.64	
11/21/2022 11:29:5...	0.36	-0.64	0.7	1.01	-2.32	-6.53	0.73	-71.91	14.67	-86.72	-78.47	32.58	
11/21/2022 11:29:5...	-0.42	-0.29	0.91	1.04	0.92	1.28	0.98	-91.41	-7.34	-130.08	-94.59	32.54	

127.0.0.1 / localhost / mtet / im...

phpMyAdmin

Server: localhost Database: mtet Table: imusensor4

Showing rows 0 - 24 (3526 total. Query took 0.0005 seconds)

SELECT * FROM 'imusensor4'

Number of rows: 25 Filter rows: Search this table

DateTime	accelerationX	accelerationY	accelerationZ	accelerationNorm	GyroX	GyroY	GyroZ	MagnetoX	MagnetoY	MagnetoZ	magHorizDirection	Temperature	Pressure	Altitude
2022-11-02 00:28:47	0	0	0	0.93	1.04	0.43	0.61	1.16	47.53	110.04	-178.13	23.36	32.18	29.93
2022-11-02 00:28:48	-0.46	0	0.92	1.03	0.49	0.85	1.04	46.31	110.04	-179.3	22.82	32.18	29.93	0
2022-11-02 00:28:48	-0.46	0	0.92	1.02	0.61	0.67	1.4	47.53	112.48	-178.13	22.91	32.19	29.93	0
2022-11-02 00:28:48	-0.46	0	0.93	1.04	0.73	0.92	1.59	49.97	108.82	-179.3	24.66	32.19	29.93	0
2022-11-02 00:28:48	-0.46	0	0.93	1.04	0.67	0.73	1.4	48.75	111.26	-179.3	23.66	32.18	29.93	0
2022-11-02 00:28:48	-0.46	0	0.92	1.02	0.67	0.98	1.46	48.75	112.48	-178.13	23.43	32.19	29.93	0
2022-11-02 00:28:48	-0.46	0	0.93	1.04	0.55	0.92	1.46	48.75	112.48	-180.47	23.43	32.18	29.93	0
2022-11-02 00:28:48	-0.46	0	0.93	1.04	0.67	0.73	1.34	45.09	110.04	-179.3	22.28	32.19	29.93	0
2022-11-02 00:28:48	-0.46	0	0.93	1.04	0.37	0.73	1.53	48.75	112.48	-178.13	23.43	32.18	29.93	0
2022-11-02 00:28:49	-0.46	0	0.93	1.03	0.55	0.92	1.34	48.75	112.48	-180.47	23.43	32.19	29.93	0
2022-11-02 00:28:49	-0.46	0	0.92	1.03	0.61	0.85	1.16	52.41	110.04	-178.13	25.47	32.18	29.93	0
2022-11-02 00:28:49	-0.46	0	0.93	1.04	0.67	1.04	1.34	52.41	110.04	-178.13	25.47	32.18	29.93	0
2022-11-02 00:28:49	-0.46	0	0.92	1.03	0.67	0.79	1.4	51.19	111.26	-178.13	24.71	32.19	29.93	0
2022-11-02 00:28:49	-0.46	0	0.92	1.03	0.67	0.79	1.4	47.53	112.48	-179.3	22.91	32.18	29.93	0
2022-11-02 00:28:49	-0.46	0	0.93	1.04	0.55	0.73	1.4	49.97	110.04	-178.13	24.42	32.18	29.93	0
2022-11-02 00:28:49	-0.46	0	0.93	1.03	0.79	0.92	1.46	47.53	108.82	-178.13	23.6	32.18	29.93	0
2022-11-02 00:28:49	-0.46	0	0.93	1.04	0.61	0.85	1.34	49.97	108.82	-181.64	24.66	32.18	29.93	0
2022-11-02 00:28:50	-0.46	0	0.92	1.03	0.61	0.73	1.65	51.19	110.04	-176.95	24.95	32.18	29.93	0
2022-11-02 00:28:50	-0.46	0	0.92	1.03	0.79	0.98	1.34	51.19	110.04	-176.95	24.95	32.18	29.93	0
2022-11-02 00:28:50	-0.46	0	0.92	1.03	0.79	0.67	1.4	49.97	110.04	-179.3	24.42	32.18	29.93	0
2022-11-02 00:28:50	-0.46	0	0.92	1.03	0.73	0.98	1.22	49.97	110.04	-178.13	24.42	32.18	29.94	0
2022-11-02 00:28:50	-0.46	0	0.92	1.03	0.67	0.92	1.28	49.97	111.26	-179.3	24.19	32.18	29.93	0

MySQL Database Result

IMU Data Monitoring by Two Tanawin

Inertial Measurement Unit: 192.168.1.111
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Connect Start SaveData StopSave StartSQL StartWithSQL
Disconnect Stop -0.41,-0.44,0.83,1.03,1.53,-0.61,1.5 State : ?

MonitoringData TableData Acc_Data Acc_Sqrt Gyro_Data Meg_Data MegDirection Temp_Press RawData MqttData WedNoedRed TabItem3

DateTime	acceleratio...	acceleratio...	acceleratio...	accelerationNor...	GyroX	GyroY	GyroZ	MagnetoX	MagnetoY	MagnetoZ	magHorizDirecti...	Temperatu...	Pre
11/2/2022 12:28:47...	0	0	0	0	0	0	0	0	0	0	0	0	
11/2/2022 12:28:47...	-0.46	0	0.93	1.04	0.43	0.61	1.16	47.53	110.04	-178.13	23.36	32.18	
11/2/2022 12:28:48...	-0.46	0	0.92	1.03	0.49	0.85	1.04	46.31	110.04	-179.3	22.82	32.18	
11/2/2022 12:28:48...	-0.46	0	0.92	1.02	0.61	0.67	1.4	47.53	112.48	-178.13	22.91	32.19	
11/2/2022 12:28:48...	-0.46	0	0.93	1.04	0.73	0.92	1.59	49.97	108.82	-179.3	24.66	32.19	
11/2/2022 12:28:48...	-0.46	0	0.93	1.04	0.67	0.73	1.4	48.75	111.26	-179.3	23.66	32.18	
11/2/2022 12:28:48...	-0.46	0	0.92	1.02	0.67	0.98	1.46	48.75	112.48	-178.13	23.43	32.19	
11/2/2022 12:28:48...	-0.46	0	0.93	1.04	0.55	0.92	1.46	48.75	112.48	-180.47	23.43	32.18	
11/2/2022 12:28:48...	-0.46	0	0.93	1.04	0.67	0.73	1.34	45.09	110.04	-179.3	22.28	32.19	
11/2/2022 12:28:48...	-0.46	0	0.93	1.04	0.37	0.73	1.53	48.75	112.48	-178.13	23.43	32.18	
11/2/2022 12:28:49...	-0.46	0	0.93	1.03	0.55	0.92	1.34	48.75	112.48	-180.47	23.43	32.19	
11/2/2022 12:28:49...	-0.46	0	0.92	1.03	0.61	0.85	1.16	52.41	110.04	-178.13	25.47	32.18	
11/2/2022 12:28:49...	-0.46	0	0.93	1.04	0.67	1.04	1.34	52.41	110.04	-178.13	25.47	32.18	
11/2/2022 12:28:49...	-0.46	0	0.92	1.03	0.67	0.79	1.4	51.19	111.26	-178.13	24.71	32.19	
11/2/2022 12:28:49...	-0.46	0	0.92	1.03	0.67	0.79	1.4	47.53	112.48	-179.3	22.91	32.18	
11/2/2022 12:28:49...	-0.46	0	0.93	1.04	0.55	0.73	1.4	49.97	110.04	-178.13	24.42	32.18	
11/2/2022 12:28:49...	-0.46	0	0.93	1.03	0.79	0.92	1.46	47.53	108.82	-178.13	23.6	32.18	
11/2/2022 12:28:49...	-0.46	0	0.93	1.04	0.61	0.85	1.34	49.97	108.82	-181.64	24.66	32.18	
11/2/2022 12:28:50...	-0.46	0	0.92	1.03	0.61	0.73	1.65	51.19	110.04	-176.95	24.95	32.18	
11/2/2022 12:28:50...	-0.46	0	0.92	1.03	0.79	0.98	1.34	51.19	110.04	-176.95	24.95	32.18	

Delphi ini File

```
procedure TForm1.callini;  
770 begin  
    iniFilePath:=ExtractFilePath(ParamStr(0)) + 'cfg.ini'; // application exe  
    if not FileExists(iniFilePath) then  
        WriteIniCfg // Set Object Config as Default  
    else  
        ReadIniCfg;  
end;
```

```
1130 procedure TForm1.reCheck;  
begin  
    if CheckBox1.IsChecked then  
    begin  
        StartSQL.Enabled:=False;  
        StopSQL.Enabled:=False;  
        ShowMessage('Start With SQL');  
    end  
    else  
    begin  
1140 StartSQL.Enabled:=True;  
        StopSQL.Enabled:=False;  
    end;  
end;
```

```
procedure TForm1.ReadIniCfg;  
var  
    vIni:TIniFile;  
begin  
    vIni:=TIniFile.Create(iniFilePath);  
    try  
        CheckBox1.IsChecked:=vIni.ReadBool(CheckBox1.ClassName, 'CheckBox1.Checked', False);  
    finally  
1110 vIni.Free;  
    end;  
end;
```

```
procedure TForm1.WriteIniCfg;  
var  
    vIni:TIniFile;  
begin  
    vIni:=TIniFile.Create(iniFilePath);  
    try  
        vIni.WriteBool(CheckBox1.ClassName, 'CheckBox1.Checked', CheckBox1.IsChecked);  
    finally  
540 vIni.Free;  
    end;  
end;
```

RecordIMU	11/21/2022 10:58 AM	File folder	
cfg	11/21/2022 12:21 PM	Configuration sett...	1 KB
FMX_IMU_TCP	11/21/2022 12:20 PM	Application	63,521 KB
Main.dcu	11/21/2022 12:10 PM	DCU File	54 KB
Project1	11/19/2022 11:02 AM	Application	63,437 KB
Unit1.dcu	11/19/2022 10:48 AM	DCU File	40 KB

Delphi Data Logging

```

type
TrecData = class(TThread)
private
protected
80  procedure Execute; override;
end;

procedure TForm1.recDataStart;
begin
if MyRec = nil then
MyRec := TrecData.Create(False);
end;

1120 procedure TForm1.recDataStop;
begin
if MyRec <> nil then
begin
Myrec.Free;
Myrec.Terminate;
Myrec := nil;
end;
end;

function TForm1.FloatToStr2(Data: Single): String;
begin
Result:= Format('%0.2f', [Data]);
end;

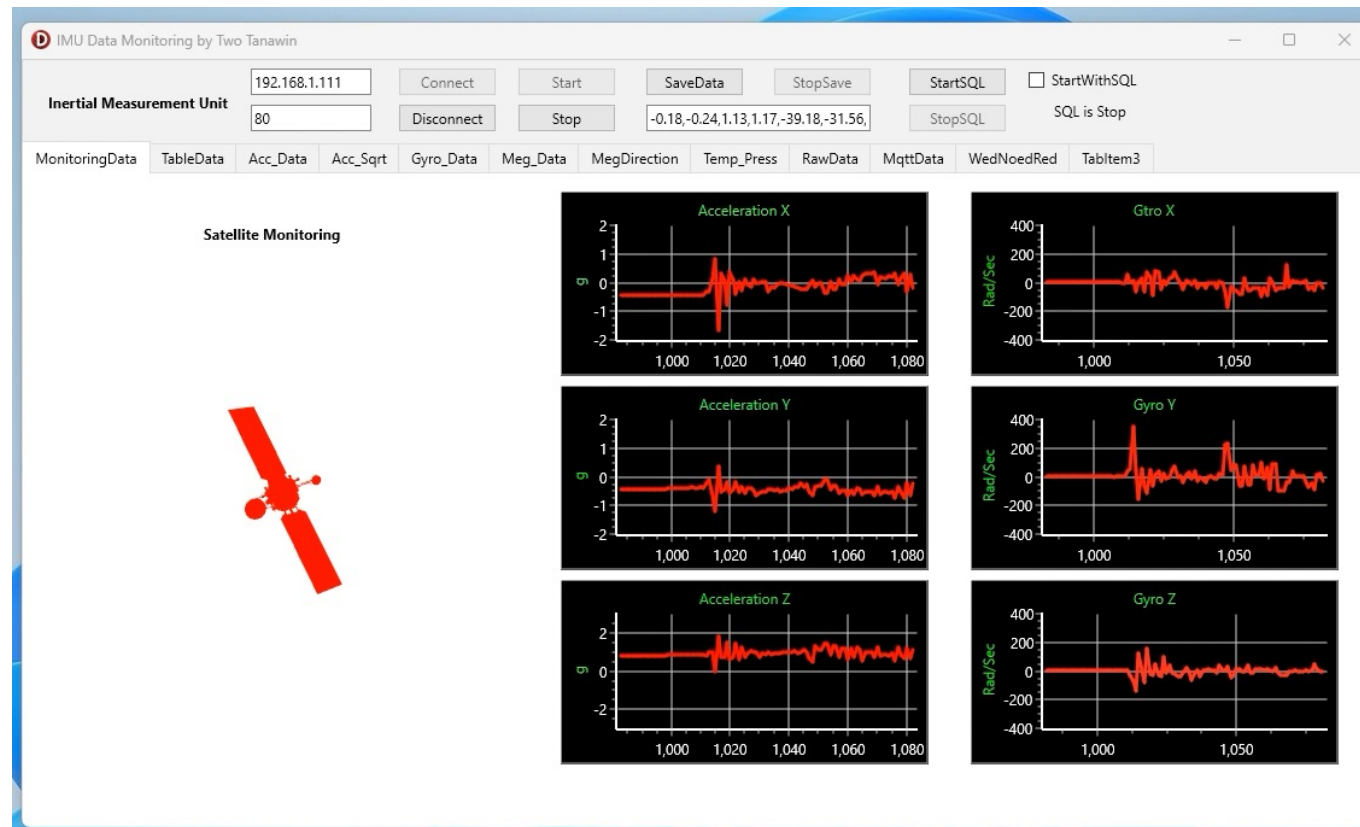
procedure TForm1.SaveDataClick(Sender: TObject);
var
Buff:String;
I,x:integer;
S:String;
begin
if Start.Enabled=True then
begin
ShowMessage('Please Enable Start');
end
else
begin
recDataStart;
SaveData.Enabled:=False;
StopSave.Enabled:=True;
end;
end;

procedure TForm1.StopSaveClick(Sender: TObject);
begin
recDataStop;
StopSave.Enabled:=False;
SaveData.Enabled:=True;
end;

procedure TrecData.Execute;
var
Buff:String;
I,x:integer;
begin
inherited;
i:=0;
AssignFile(Form1.MyDataFile, 'RecordIMU\'+FormatDateTime('hh_nn_ss', Now)+Form1.MyDataPath); {Assigns the Filename}
Rewrite(Form1.MyDataFile); {Create a new file }
Buff:='No, Time, AccX, AccY, AccZ, AccNorm, GyroY, GyroZ';
Writeln(Form1.MyDataFile, Buff);
repeat
Application.ProcessMessages;
Inc(i);
Sleep(100);
Form1.MyData.accX:=StrToFloat(Form1.accData.aX);
Form1.MyData.accY:=StrToFloat(Form1.accData.aY);
Form1.MyData.accZ:=StrToFloat(Form1.accData.aZ);
Form1.MyData.accNorm:=StrToFloat(Form1.accData.rq);
Form1.MyData.gyroR:=StrToFloat(Form1.gyroData.gyroX);
Form1.MyData.gyroP:=StrToFloat(Form1.gyroData.gyroY);
Form1.MyData.gyroY:=StrToFloat(Form1.gyroData.gyroZ);
1310 Buff := IntToStr(i)+' '+FormatDateTime('dd-mm-yyyy hh:nn:ss', Now)+' '+Form1.FloatToStr2(Form1.MyImu[i].accX)+' '+
+Form1.FloatToStr2(Form1.MyImu[i].accY)+' '+Form1.FloatToStr2(Form1.MyImu[i].accZ)+' '+Form1.FloatToStr2(Form1.MyImu[i].accNorm)
+Form1.FloatToStr2(Form1.MyImu[i].gyroR)+' '+Form1.FloatToStr2(Form1.MyImu[i].gyroP)+' '+Form1.FloatToStr2(Form1.MyImu[i].gyroY);
1320 Writeln(Form1.MyDataFile, Buff);
until Terminated;
CloseFile(Form1.MyDataFile); {Closes file } //save
end;

```

Delphi Data Logging



Delphi Data Logging

SaveData StopSave

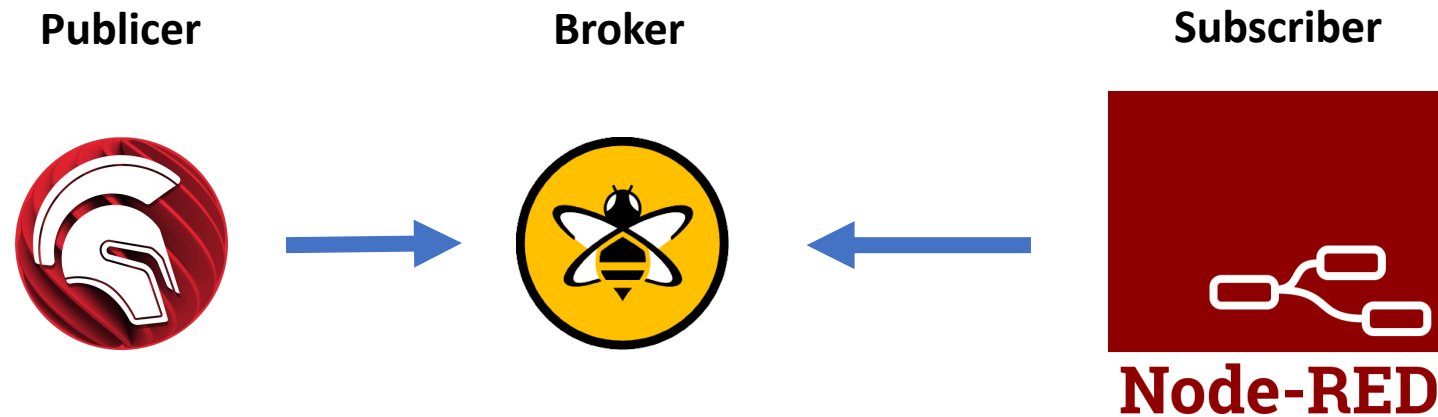
RecordIMU	11/21/2022 10:58 AM	File folder	
cfg	11/21/2022 12:21 PM	Configuration sett...	1 KB
FMX_IMU_TCP	11/21/2022 12:20 PM	Application	63,521 KB
Main.dcu	11/21/2022 12:10 PM	DCU File	54 KB
Project1	11/19/2022 11:02 AM	Application	63,437 KB
Unit1.dcu	11/19/2022 10:48 AM	DCU File	40 KB

10_58_03MyFile - Notepad

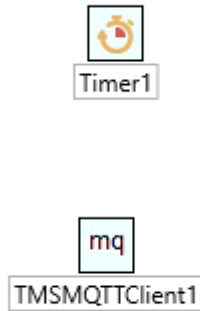
File Edit View

```
No, Time, AccX, AccY, AccZ, AccNorm, GyroY, GyroZ
1,21-11-2022 10:58:03,0.22,-0.38,-0.38,0.89,-50.66,76.29,-79.53
2,21-11-2022 10:58:03,-0.11,-0.52,-0.52,0.99,262.21,-12.15,35.64
3,21-11-2022 10:58:03,-0.28,1.00,1.00,1.68,-224.85,74.58,-151.37
4,21-11-2022 10:58:03,0.20,-1.46,-1.46,1.70,54.75,-54.69,58.59
5,21-11-2022 10:58:03,-2.51,1.85,1.85,4.56,267.88,52.12,45.23
6,21-11-2022 10:58:03,0.34,-0.80,-0.80,1.20,-346.92,-40.53,-108.03
7,21-11-2022 10:58:03,0.35,-0.26,-0.26,0.87,-180.85,88.01,-287.48
8,21-11-2022 10:58:04,0.22,-0.84,-0.84,1.03,259.95,-121.70,216.37
9,21-11-2022 10:58:04,-0.03,0.65,0.65,1.86,-432.19,-196.47,-163.94
10,21-11-2022 10:58:04,0.99,-1.16,-1.16,1.59,46.94,-132.81,196.90
11,21-11-2022 10:58:04,-1.41,1.73,1.73,3.43,-156.43,-208.01,-48.95
12,21-11-2022 10:58:04,0.46,-1.79,-1.79,1.93,-95.70,-62.38,37.41
13,21-11-2022 10:58:04,0.97,-0.96,-0.96,1.45,77.70,-33.14,134.70
14,21-11-2022 10:58:04,0.94,-0.33,-0.33,1.28,-187.19,203.31,-180.97
15,21-11-2022 10:58:04,-0.88,1.02,1.02,2.50,361.57,152.47,78.37
16,21-11-2022 10:58:04,0.40,-0.07,-0.07,0.86,-194.40,48.58,-211.98
17,21-11-2022 10:58:04,0.66,-0.22,-0.22,1.09,295.23,16.05,231.08
18,21-11-2022 10:58:05,0.32,0.00,0.00,1.41,-234.31,-14.53,-188.23
19,21-11-2022 10:58:05,0.63,-2.03,-2.03,2.16,49.74,-130.98,126.04
20,21-11-2022 10:58:05,-1.27,1.52,1.52,3.17,-112.55,-144.47,-35.95
21,21-11-2022 10:58:05,0.55,-1.51,-1.51,1.74,-246.28,17.21,-68.79
22,21-11-2022 10:58:05,0.13,0.34,0.34,1.66,361.57,203.61,132.20
23,21-11-2022 10:58:05,0.23,-0.15,-0.15,1.21,-253.11,35.46,-237.79
24,21-11-2022 10:58:05,0.68,-0.13,-0.13,0.88,-91.61,156.80,-224.67
25,21-11-2022 10:58:05,-0.26,1.59,1.59,2.81,-429.50,-110.60,-33.14
26,21-11-2022 10:58:05,-0.14,-0.49,-0.49,1.40,-475.83,-145.63,-239.14
27,21-11-2022 10:58:05,1.35,-1.06,-1.06,1.80,-73.91,210.33,-326.54
28,21-11-2022 10:58:06,0.49,-0.11,-0.11,1.21,119.63,-146.97,277.34
29,21-11-2022 10:58:06,0.58,-1.11,-1.11,1.45,-368.16,16.24,-163.88
```

Datavisualization Using Node-RED



Delphi Conect MQTT



```
430  const
      ChatChannel = 'sensor1';

procedure TForm1.CallMqtt;
begin
  TMSMQTTClient1.BrokerHostName := 'broker.mqttpdashboard.com';
  TMSMQTTClient1.Connect();
  memo2.Lines.Add('Connect');
end;

procedure TForm1.RunMqtt;
begin
  TMSMQTTClient1.Publish(ChatChannel, TMSMQTTClient1.ClientID+'!' + memo2.Lines.Text);
  memo2.Lines.Clear;
1170 end;
```

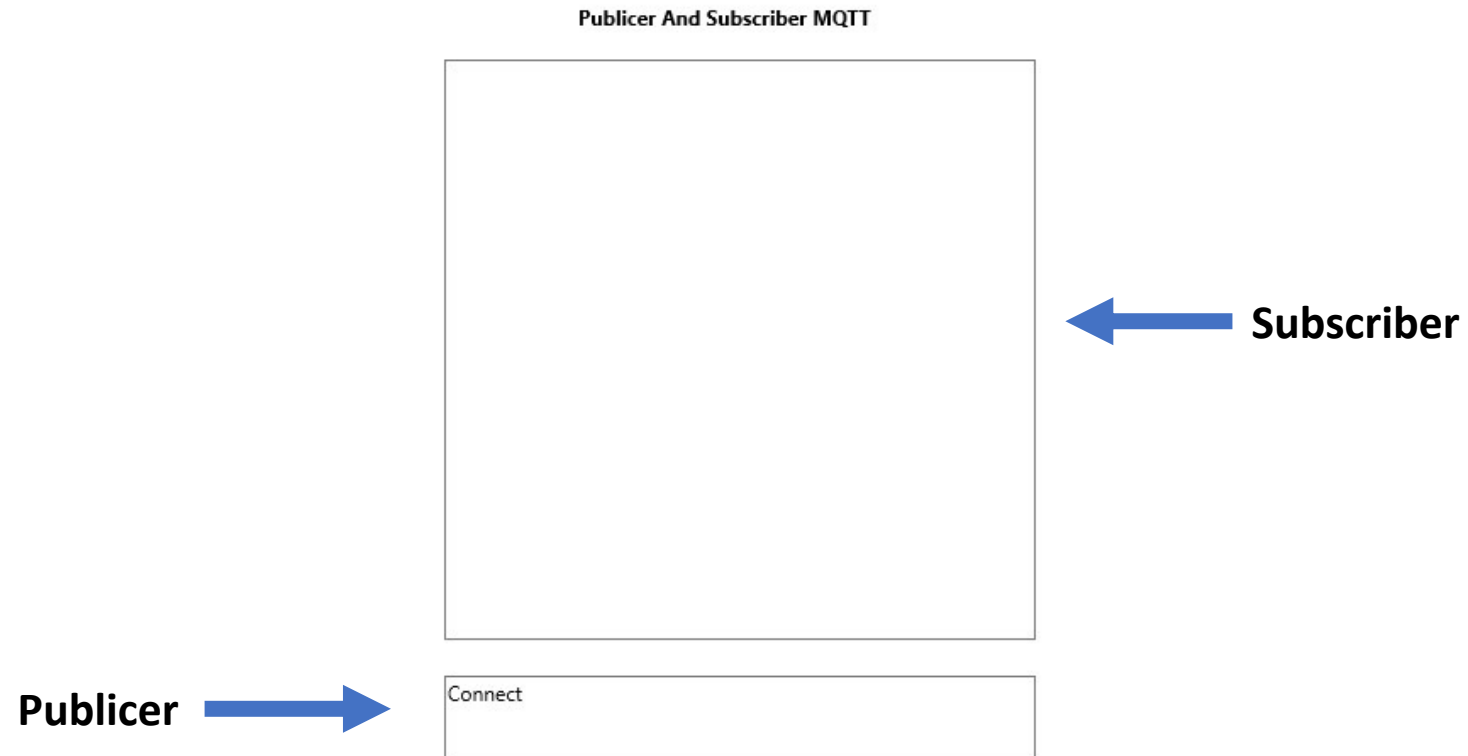
Delphi Connect MQTT

```
procedure TForm1.Timer1Timer(Sender: TObject);
begin
  Application.ProcessMessages;
  RunMqtt;
  Memo2.Lines.Add(', ' + accData.aX + ', ' + accData.aY + ', ' + accData.aZ + ', ' + gyroData.gyroX + ', ' + gyroData.gyroY + ', ' + gyroData.gyroZ);
end;
```

```
procedure TForm1.TMSMQTTClient1ConnectedStatusChanged(ASender: TObject;
  const AConnected: Boolean; AStatus: TTMSMQTTConnectionStatus);
begin
  if AConnected then
  begin
    TMSMQTTClient1.Subscribe(ChatChannel);
  end
  else begin
    case AStatus of
      csConnectionRejected_InvalidProtocolVersion,
      csConnectionRejected_InvalidIdentifier,
      csConnectionRejected_ServerUnavailable,
      csConnectionRejected_InvalidCredentials,
      csConnectionRejected_ClientNotAuthorized; // the connection is rejected by broker
    csConnectionLost; // the connection with the broker is lost
    csConnecting; // The client is trying to connect to the broker
    csReconnecting; // The client is trying to reconnect to the broker
    end;
  end;
end;
```

```
procedure TForm1.TMSMQTTClient1PublishReceived(ASender: TObject;
  APacketID: Word; ATopic: string; APayload: TArray<System.Byte>);
var
  msg, orig: string;
  vp: integer;
  alright: boolean;
begin
  msg := TEncoding.UTF8.GetString(APayload);
  vp := pos('!', msg);
  if vp > 0 then
  begin
    orig := copy(msg, 1, vp - 1);
    alright := orig <> TMSMQTTClient1.ClientID;
    msg := copy(msg, vp + 1, Length(msg));
    AddMessage(msg, alright);
  end;
end;
```

Delphi Connect MQTT



Delphi Connect MQTT


Messages			⌵
2022-11-22 14:27:07	Topic: sensor1	Qos: 0	
4YmX0ZJEa4QUZYjDz6g1TakI,-0.46,-0.48,0.79,0.55,0.73,1.28			
2022-11-22 14:27:07	Topic: sensor1	Qos: 0	
4YmX0ZJEa4QUZYjDz6g1TakI,-0.46,-0.48,0.78,0.85,1.10,0.79			
2022-11-22 14:27:06	Topic: sensor1	Qos: 0	
4YmX0ZJEa4QUZYjDz6g1TakI,-0.46,-0.49,0.78,0.49,0.49,1.65			
2022-11-22 14:27:06	Topic: sensor1	Qos: 0	
4YmX0ZJEa4QUZYjDz6g1TakI,-0.46,-0.48,0.78,2.44,2.56,-2.01			
2022-11-22 14:27:06	Topic: sensor1	Qos: 0	
4YmX0ZJEa4QUZYjDz6g1TakI,-0.46,-0.48,0.78,-0.55,0.00,2.56			
2022-11-22 14:27:06	Topic: sensor1	Qos: 0	
4YmX0ZJEa4QUZYjDz6g1TakI,-0.46,-0.48,0.79,1.28,1.34,-0.18			
2022-11-22 14:27:05	Topic: sensor1	Qos: 0	
4YmX0ZJEa4QUZYjDz6g1TakI,-0.46,-0.48,0.79,-0.18,-0.06,2.20			
2022-11-22 14:27:05	Topic: sensor1	Qos: 0	
4YmX0ZJEa4QUZYjDz6g1TakI,-0.46,-0.49,0.78,1.95,2.38,-1.59			
2022-11-22 14:27:05	Topic: sensor1	Qos: 0	
4YmX0ZJEa4QUZYjDz6g1TakI,-0.45,-0.49,0.78,0.06,-0.37,2.50			
2022-11-22 14:27:05	Topic: sensor1	Qos: 0	
4YmX0ZJEa4QUZYjDz6g1TakI,-0.46,-0.48,0.78,1.22,1.04,0.73			

Form Creat & Close


```
procedure TForm1.FormCreate(Sender: TObject);
var
  I: Integer;
960 begin
  IdTCPCClient1.Host := Edit1.Text;
  IdTCPCClient1.Port := StrToInt(Edit2.Text);
  PreModel;
  SetZero;
  ThreadPlotStart;
  callMqtt;
  Thread3dStart;
  MyDataPath:=ExtractFilePath(Application.Name)+'MyFile.txt';
  Disconnect.Enabled:=False;
970 Stop.Enabled:=False;
  StopSQL.Enabled:=False;
  StopSave.Enabled:=False;
  callini;
  reCheck;
end;
```

```
procedure TForm1.FormClose(Sender: TObject; var Action: TCloseAction);
begin
  ThreadModelStop;
  EndThreadSQL;
  EndThreadPlot;
950 recDataStop;
  EndThread3d;
  StopClient;
  Timer1.Enabled:=False;
  Application.Terminate;
end;
```


Hive MQTT

 **HIVEMQ**

Websockets Client Showcase

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Connection ● connected 

Host
broker.mqttdashboard.com

Port
8000

ClientID
clientid-4OIJYJDdUU

Disconnect

Username

Password

Keep Alive
60

SSL
☐


Clean Session
☒

Last-Will Topic

Last-Will QoS
0

Last-Will Retain
☐

Last-Will Message

Publish 


Topic
testtopic/1

QoS
0

Retain
☐

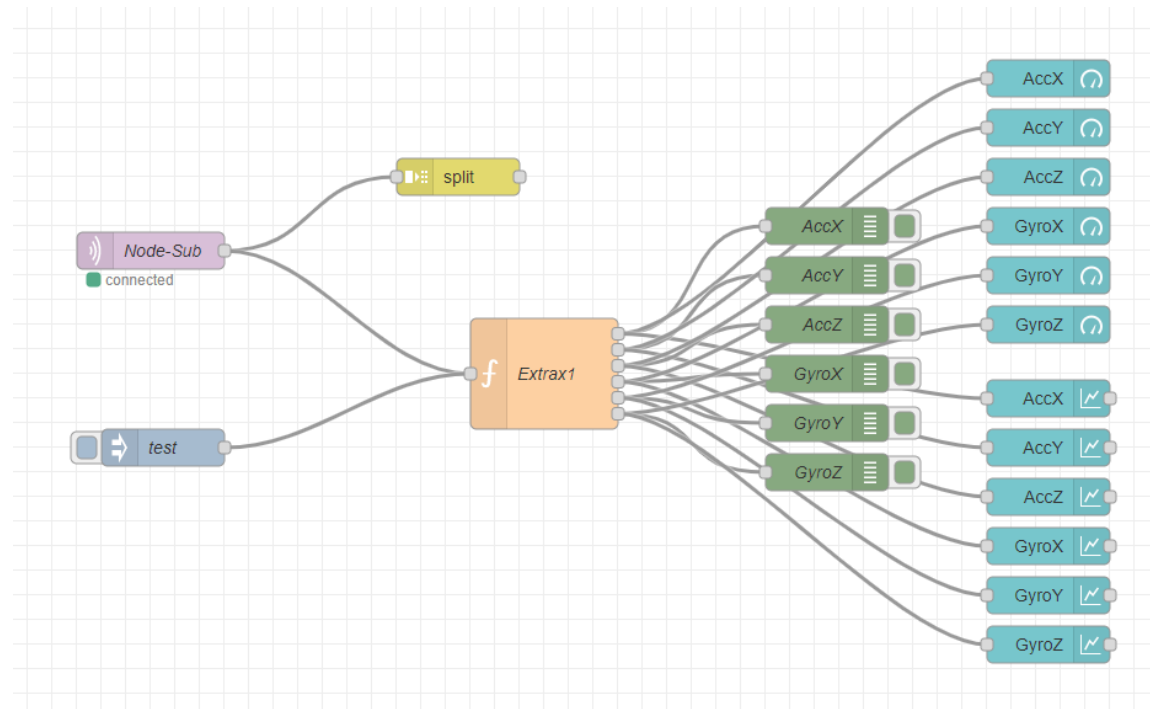
Publish

Message

Subscriptions 

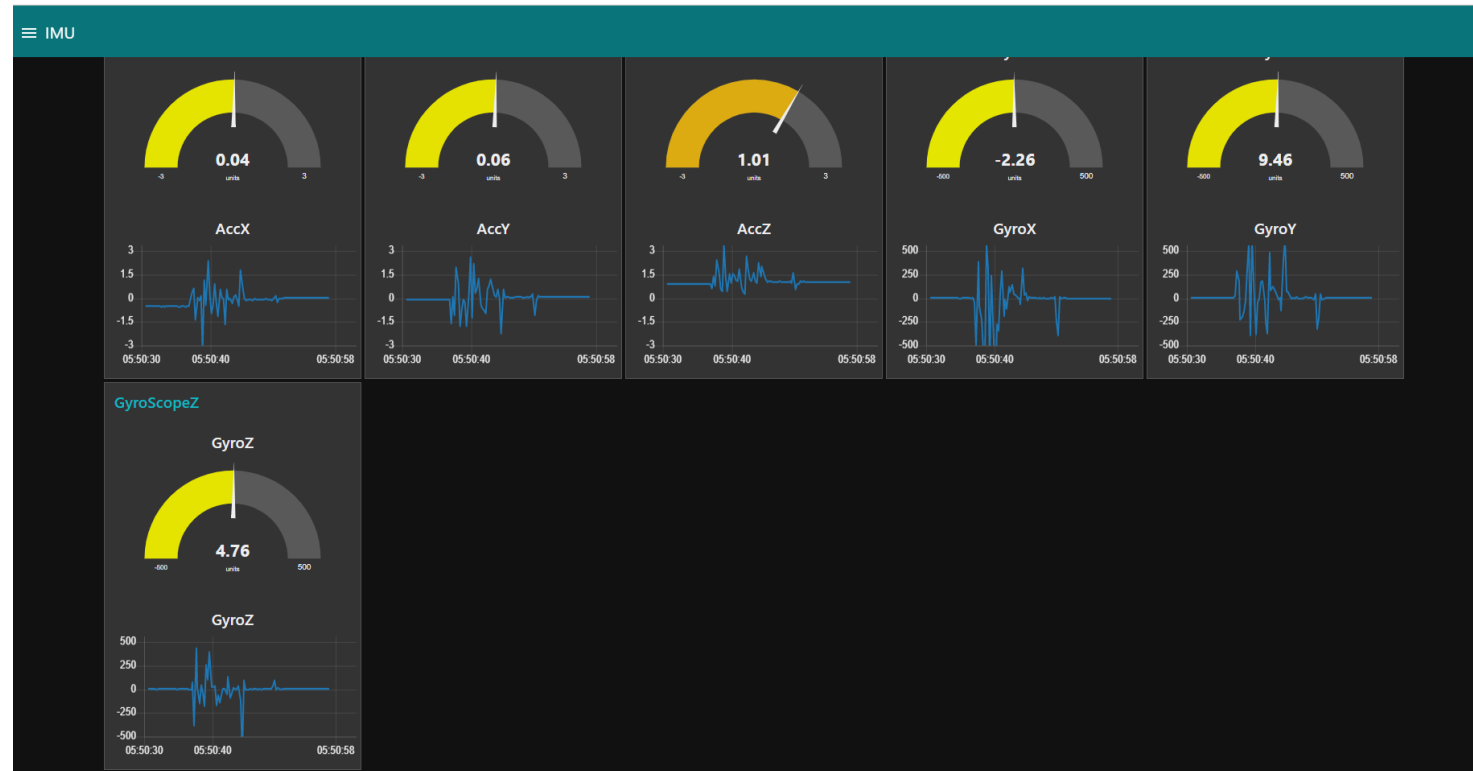
[Add New Topic Subscription](#)

Node-Red Extrax Data

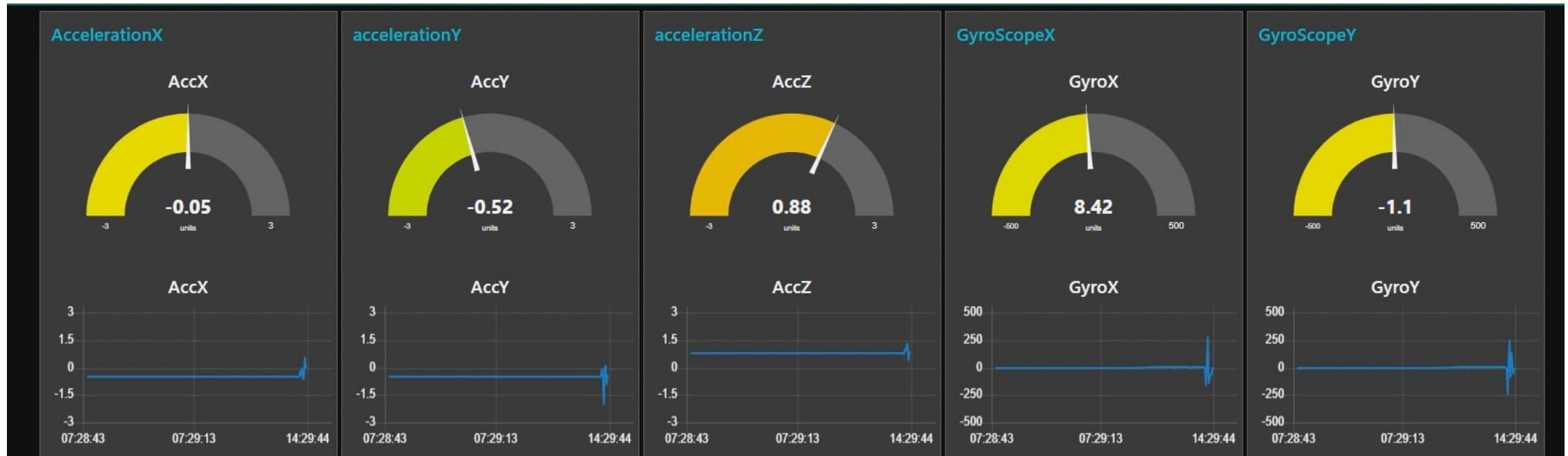


```
1 var outputMsgs = [];  
2 var words = msg.payload.split(",");  
3 // for (var w in words) {  
4 //   outputMsgs.push({ payload: words[w] });  
5 // }  
6 var text = { payload: words[0] };  
7 var accx = { payload: words[1] };  
8 var accy = { payload: words[2] };  
9 var accz = { payload: words[3] };  
10 var gyrox = { payload: words[4] };  
11 var gyroy = { payload: words[5] };  
12 var gyroz = { payload: words[6] };  
13 // var out7 = { payload: words[7] };  
14 return [accx, accy, accz, gyrox, gyroy, gyroz];
```

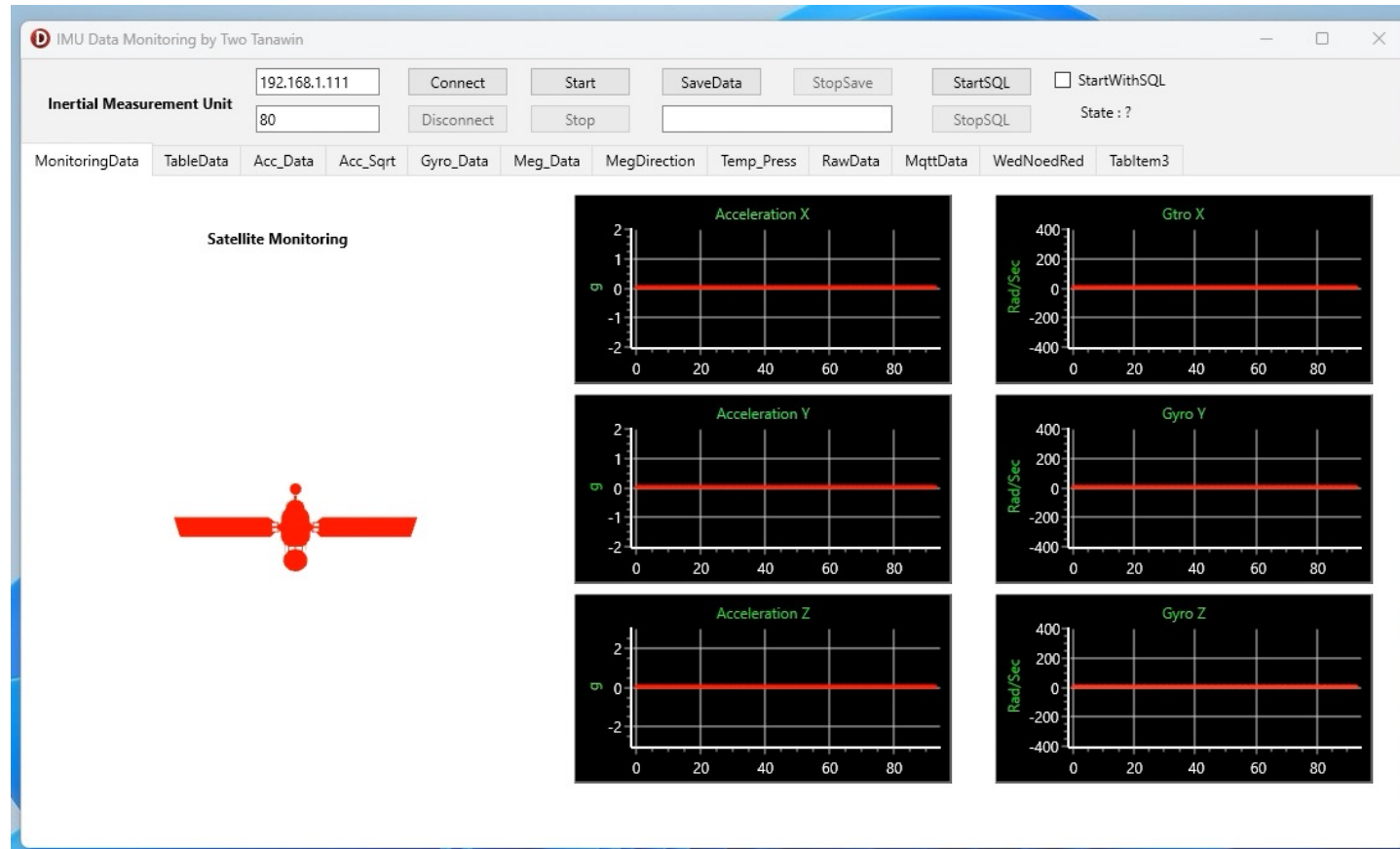
Datavisualization Using Node-RED



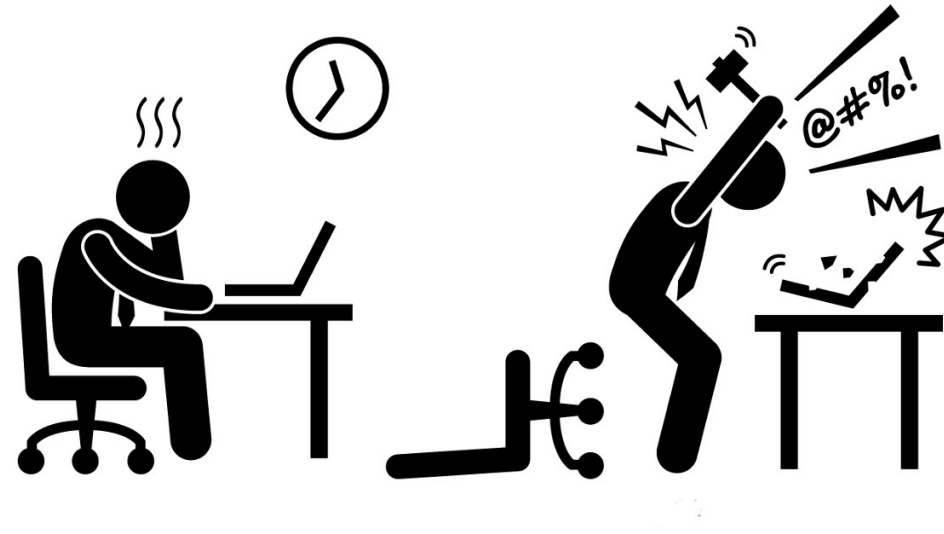
Datavisualization Using Node-RED



IoT Inertial Mesuament Unit Monitoring



Problem



Applied



Deploy Other Device



Monitoring Real Machine

THE END THX