

Direct Data Uploading to Microsoft Excel by Using Parallax Data Acquisition Software and Arduino

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Abstract

Physical data such as temperature, humidity, heat index, atmospheric pressure and altitude are detected from the DHT11 sensor and BMP180 sensor by using microcontroller. These data are processed by microcontroller and these are displayed on the LCD display. Then, using Parallax data acquisition (PLX-DAQ) these data are uploaded to the Microsoft (MS) Excel spreadsheet directly from Arduino. Parallax data acquisition (PLX-DAQ) is a simple add-on for Microsoft Excel that make it to create log excel sheets for laboratory purpose or other DAQ purposes. Using PLX_DAQ software, no need to list the data in Excel but data is directly logged in the MS Excel spreadsheet and moreover, data can be plotted in live graph. In this research, Arduino microcontroller, LCD and DHT 11 temperature and humidity sensor and BMP180 barometric sensor are used in hardware section while Parallax data acquisition (PLX-DAQ), Arduino IDE and DHT11 library and BMP 180 library are contributed in software section.

Keywords: MS Excel, data acquisition, PLX_DAQ.

1. Introduction

In conventional experiment, data are noted manually and these are listed and plotted in the Microsoft(MS) Excel spreadsheet. In this research, physical data are detected from the sensors and these data are directly uploaded to Microsoft Excel spreadsheet using microcontroller and Parallax Data Acquisition (PLX_DAQ) software. Moreover, it can be plotted in live graph. Parallax Data Acquisition tool (PLX-DAQ) software add-in for Microsoft Excel acquires up to 26 channels of data from any Parallax microcontrollers and drops the numbers into columns as they arrive. PLX-DAQ provides spreadsheet analysis of data collected in the field, laboratory analysis of sensors and real-time equipment monitoring.

2. Materials and Method

In this research, Arduino uno microcontroller is functioned as the processing unit to display, to log and to upload data. DHT11 and BMP180 are used as the temperature/humidity detector and barometric pressure sensor. The parallax data acquisition (PLX-DAQ) software are required to implement the research. There are two main sections:-software preparation and hardware preparation in the direct data uploading to MS Excel.

2.1. Preparation of PLX-DAQ software

Data acquisition (DAQ) is the process of measuring an electrical or physical measurable such as voltage, current, temperature, pressure, or humidity with a computer or microcontroller. A DAQ system consists of sensors, DAQ measurement hardware, and a microcontroller with programmable software such as Assembly, Basic, C, C++, C#, Fortran, Java, LabView, lisp, Pascal, etc. [4].

2.1.1. Enabling the Macro and Active-X

As Macro is a small program, Excel doesn't allow macros to run by default because it maybe a virus that will delete all your office files. In order to enable it the following will be done.

1. Show the hidden "developer" tab as shown in figure1.
2. Enable the "Macro" as shown in figure 2.

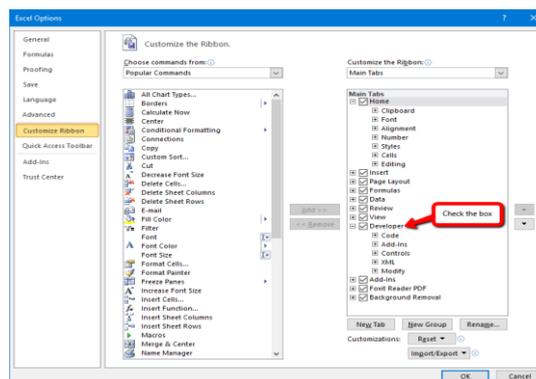


Figure 1. Showing the hidden"developer"

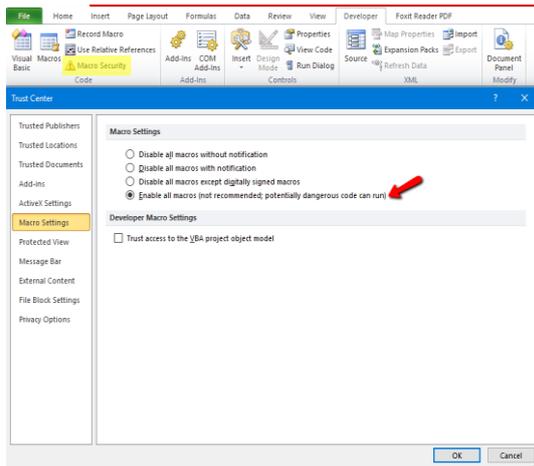


Figure 2. Enable “Micro”

2.1.2. Data logging Preparation for PLX_DAQ Window

Excel is not started by the usual procedure; it is started from the macro. Once Installed, excel is started through the shortcut in the desktop folder. One needs to allow the macro to run and then this window is displayed over an Excel sheet. This is used to make the connection and start Excel. The connection is made via the USB cable in the normal manner, and the port is the same as that used by the Arduino IDE. The baud rate must match that in the Serial.begin command in the Arduino program. By having the Reset on Connect box ticked, serial commands in the setup section of the Arduino program will be implemented. At the start Excel opens with a dummy sheet. Ignore this; it will dump it when Arduino starts. The PLX_DAQ window is illustrated in figure 3 when Arduino program is run and connected to Excel by clicking the connect button in the PLX window. The control box is shown in figure 4. The baud rate is chosen as 9600 in this research which is most common to any Arduino microcontroller. At baud rates above 76,800, the cable length will need to be reduced.

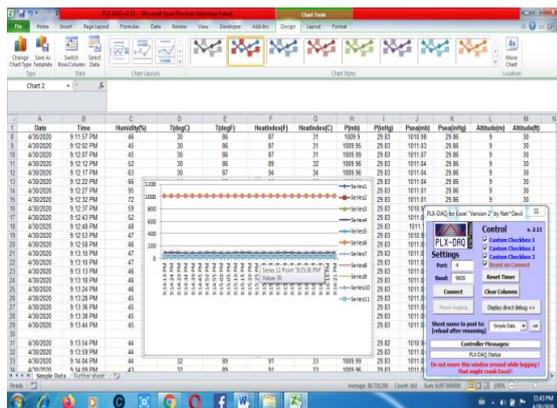


Figure 3. PLX_DAQ window



Figure 4. Control box of PLX_DAQ window

2.1.3. Live Graphs

It is normal Excel, the data feed into the cells. By connecting PLX_DAQ software to Arduino, data are listed directly in Excel. To run live graph, it is usually one where data is measured against. If one wants to start at a specific point, the Clear Columns button in the PLX-DAQ window is used. No need to reset Arduino or reconnects. Live graph of physical data with respect to time will be plotted. [4]

2.2. Hardware Preparation

Direct data uploading system consists of DHT 11 sensor, BMP180 barometric sensor, 20×4 LCD and Arduino microcontroller. Humidity in percentage, Temperature in °C or °F, heat index in °C or °F, can be detected from DHT11 while standard pressure at sea level in mb or in Hg, pressure at a certain location in in mb or in Hg, and altitude(elevation) in m or ft .

2.2.1. DHT11 Sensor

This DFRobot DHT11 temperature and humidity sensor (in figure 5) features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature and humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high-performance 10-bit microcontroller, offering excellent quality, fast response, anti-interference ability and cost-effectiveness. A complete data transmission is 40bit, and the sensor sends higher data bit first.

Data format = 8bit integral RH data + 8bit decimal RH data + 8bit integral T data + 8bit decimal T data + 8bit check sum. If the data transmission is right, the check-sum should be the last 8bit of "8bit integral RH data + 8bit decimal RH data + 8bit integral T data + 8bit decimal T data". Data transmission is expressed in figure 5. [5].

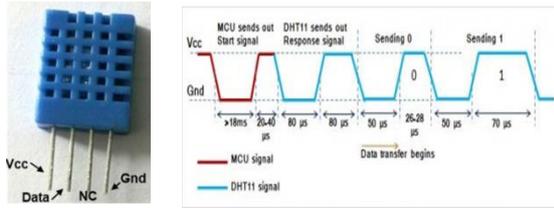


Figure 5. DHT 11 and its data transmission

2.2.2. BMP180 Barometric Sensor

BMP180 is designed to measure Barometric Pressure or Atmospheric pressure. BMP180 is a high precision sensor designed for consumer applications. [3]

3. System Operation

Arduinouno, DHT 22, BMP 180 and LCD are used in sensor data acquisition system. The schematic circuit diagram drawn by Proteus software is shown in figure 7. DHT 11 consists of 4 pins: Vcc (pin 1), data (pin 2), NC (pin3) and ground (pin4). Data pin is connected to the D9 of Arduino. The Rs, R/W, DB4, DB5, DB6 and DB7 of LCD are connected to D7, D6, D5, D4, D3 and D2 of Arduino. BMP180 is the I2C device so that its serial data pin SDA and serial clock SCL are connected to the A4 and A5 of Arduino respectively. Interfacing the Arduino to Excel can be completed using a Parallax Data Acquisition (PLX-DAQ) software free add-in for Microsoft Excel. To interface the Arduino to Excel, the Arduino would first have to be programmed with the Arduino software (IDE). The block diagram of direct data logging system is as shown in figure 6. [2], [4].

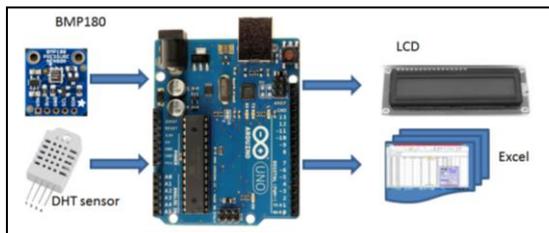


Figure 6. Block diagram of data logging system

To display on LCD the program code can be written as usual but to show on excel, use the following program codes.

```
Serial.println("CLEARDATA");
Serial.println("LABEL,Date,Time,Humidity(%),T(degC),T(degF),HeatIndex(F),HeatIndex(C),P(mb),P(in Hg), Psea(mb),Psea(inHg),Altitude(m),Altitude(ft)");
Serial.print("DATA,DATE,TIME,");
Serial.print(h,0);Serial.print(",");
Serial.print(t,0);Serial.print(",");
Serial.print(f,0);Serial.print(",");
```

```
Serial.print(hif,0);Serial.print(",");
Serial.print(hic,0);Serial.print(",");
Serial.print(P,2)Serial.print(",");
Serial.print(P*0.0295333727,2);
Serial.print(a,0);Serial.print(",");
Serial.println(a*3.28084,0);
```

Once the Arduino code is uploaded into the Arduino, click on the PLX-DAQ spreadsheet icon.

BMP180 sensor senses that pressure and provides that information in digital output. Also the temperature affects the pressure and the temperature is needed to compensate the pressure reading. It is an inter-integrated circuit(I2C) device so that it has two data connection pins; serial clock(SCL) and serial data(SDA) which are connected to analog pin A5 and A4 of Arduino, respectively. The pin diagram of BMP180 is as shown in figure 7. The schematic circuit diagram is shown in figure8. [3].



Figure 7. BMP180 and its connection to Arduino

Choose the port the Arduino is connected to, check the Download Data box, and then click Connect. A graph can be added to see real-time plotting.

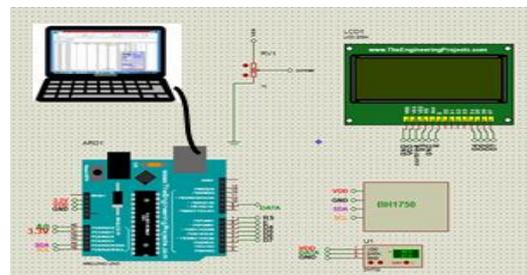


Figure 8. Schematic circuit connection

4. Results

The current results are displayed on both LCD and Excel spreadsheet. The data on LCD can only show the current value but it can be noted manually. The data on Excel spreadsheet can express the current value and it can be logged like computer manner. The figure 9 shows the results on LCD. The list of data on Excel spreadsheet is shown in figure 10. These data are recorded in 30th May 2020. The list of data with live graph is shown in figure 11. The

graph for the variation of humidity, temperature in °C and heat index with time are shown in figure11. The live graph is illustrated in figure 12. The data in figures 11 and 12 are recorded in 6 June 2020. The data expressed in this paper are not the same because of time and weather. These data are shown for examples. The live graphs can be drawn as usual excel spreadsheets for user need. The live graphs in this paper are drawn for the variation of Humidity, temperature and heat index with time for each day. The altitude and pressure do not change for same locality and where these are skipped for live graph.



Figure 9. (a) and (b) Data on LCD

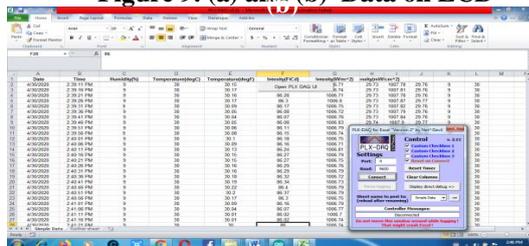


Figure 10. List of data on Excel

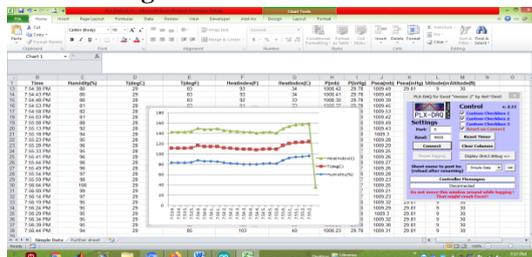


Figure 11. List of data with graph

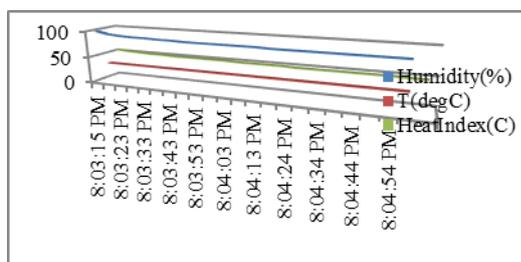


Figure 12. Live graph on Excel

5. Discussion

PLX-DAQ is working on the UART serial communication thus the Serial.print() and other functions from the serial class can be used. For this reason, the serial monitor or serial plotter cannot be used simultaneously while PLX-DAQ is using. PLX-DAQ can be used to log physical data in excel. If data refreshing time is 10minutes, 6 data in an hour, 144data points in a day and 52569 data points in a year will be recorded. There are no need of labor, labor charges and manual computation. As PLX-DAQ is open source software, this system is cost effective. It can log 26 data in the same time. If more than 26 physical quantities need to be logged, PLX-DAQ software cannot be used. PLX-DAQ software can be used for office 2007 and above, and for window xp and above. [4]

6. Conclusion

This system which gives the list and graph of the physical data with time stamp becomes value-added data. These data can be processed according to the MS Excel procedures. This system can be used in research centers and weather stations where the data have to record in specific time while manual record can be missed the valuable data.

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