LAB REPORT

MCTA 3203

SECTION 1

GROUP D

EXPERIMENT 6

DAQ interfacing with Microcontrollers

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Abstract

When an Arduino microcontroller is interfaced with PLX-DAQ software, a smooth communication channel for data transfer is established between the Arduino and the PC. The user-friendly Excel add-in PLX-DAQ (Parallel Logic's Data Acquisition) makes it easier to collect data in real time from Arduino-based applications. Data from sensors or actuators on the Arduino platform can be collected, visualized, and analyzed thanks to this connection.

In order to accomplish this, PLX-DAQ software is used to create a serial communication link between the Arduino and the computer, and the Arduino is configured to collect data from sensors or other input devices. Using an Excel spreadsheet, PLX-DAQ prepares and presents the data in real time after receiving it from the Arduino via a serial port on the computer.

Researchers, engineers, and enthusiasts can easily monitor and record data from their Arduino projects with this interface. By offering an intuitive interface for data collection and analysis, it expands the capabilities of Arduino and makes it a useful tool for a wide range of applications, including environmental monitoring, scientific research, and projects where real-time data feedback is essential. When PLX-DAQ and Arduino are used together, data acquisition becomes easier and more accessible to a wider range of users who don't have a lot of programming experience.

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Introduction

Data Acquisition (DAQ) and Microcontroller Interfacing constitute a fundamental aspect of modern experimental setups, offering a bridge between the physical world and computational analysis. In laboratory environments, the integration of DAQ systems with microcontrollers is instrumental in facilitating precise measurements, real-time monitoring, and interactive control. This synergy empowers researchers and engineers to gather accurate data from sensors, enabling a deeper understanding of the physical phenomena under investigation.

Microcontrollers, with their compact size and computational capabilities, serve as the central processing units within experimental setups. The integration of DAQ systems enhances the functionality of microcontrollers by enabling them to interface seamlessly with a diverse array of sensors, transducers, and actuators. This collaboration is pivotal in experimental sciences, where acquiring and analyzing data in real-time is essential for accurate observations and informed decision-making.

Throughout this lab report, we will delve into the principles and applications of DAQ interfacing with microcontrollers. By exploring the integration of these technologies, we aim to demonstrate their significance in experimental setups, emphasizing their role in advancing data acquisition methodologies and fostering a deeper understanding of physical phenomena in a laboratory context.

Materials and Equipment

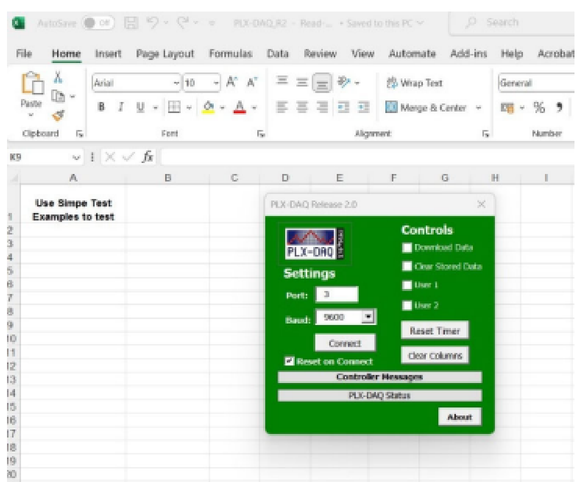
Material needed:

1. PLX-DAQ
2. Arduino Board
3. LDR
4. LM35
5. Jumper Wires
6. Resistor
7. Breadboard

Experimental Setup

1. The Arduino IDE is to be launched, and the example code shown below is to be typed and verified.

2. PLX-DAQ is to be downloaded and installed.
3. It is to be launched, and there should be an Excel spreadsheet with a pop-out GUI window in the folder, as shown below.



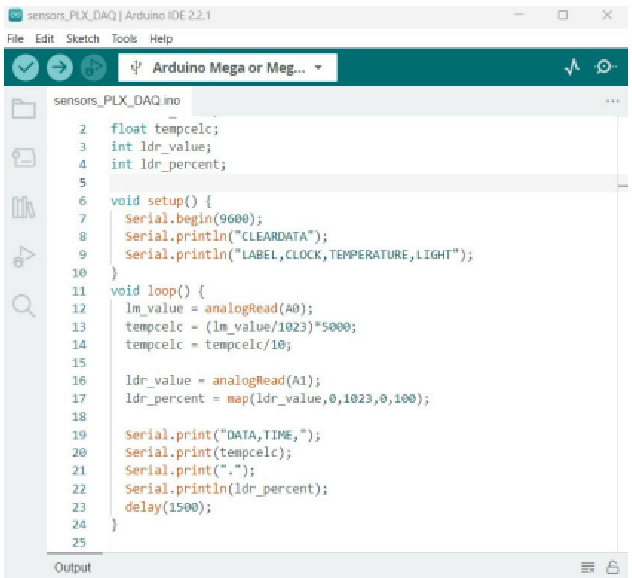
4. In the GUI, the correct COM port number is to be selected, and it is to be ensured that the baud rate is the same as the one written in the code.

5. Once done, the connect tab is to be pressed, and the data from the Arduino will be displayed in the spreadsheet.
6. The received data may now be observed, and all tools available in MS Excel can be used for analysis.

Time	Started Time	Register value
13:57:42	0.01	1022
13:57:44	1.46	1021
13:57:45	2.95	1022
13:57:47	4.46	654
13:57:48	5.95	80
13:57:50	7.46	0
13:57:51	8.96	129
13:57:53	10.47	296
13:57:54	11.96	389
13:57:56	13.46	441
13:57:57	14.96	548
13:57:59	16.46	509
13:58:00	17.97	134
13:58:02	19.46	0
13:58:03	20.96	314
13:58:05	22.47	536
13:58:06	23.97	987
13:58:08	25.47	803
13:58:09	26.96	539
13:58:11	28.48	666
13:58:12	29.98	1022
13:58:14	31.47	789
13:58:15	32.97	771
13:58:17	34.48	480
13:58:18	35.98	699
13:58:20	37.48	883
13:58:21	38.97	880

Methodology

1. Upon the construction of the circuit, Arduino IDE was launched, and code was written to enable Arduino in reading analog signals from the LM35 and LDR, converting them into digital format.
2. The example code below was completed.



3. The code was verified and subsequently uploaded to the Arduino board.
4. The PLX-DAQ spreadsheet was opened, ensuring the correct com port selection, and then, the output from the sensors was generated within the spreadsheet.
5. Within the report, comprehensive comments were provided to elucidate each line of the code, alongside the creation of meaningful excel plots derived from the sensors' data.

Results (Observation)

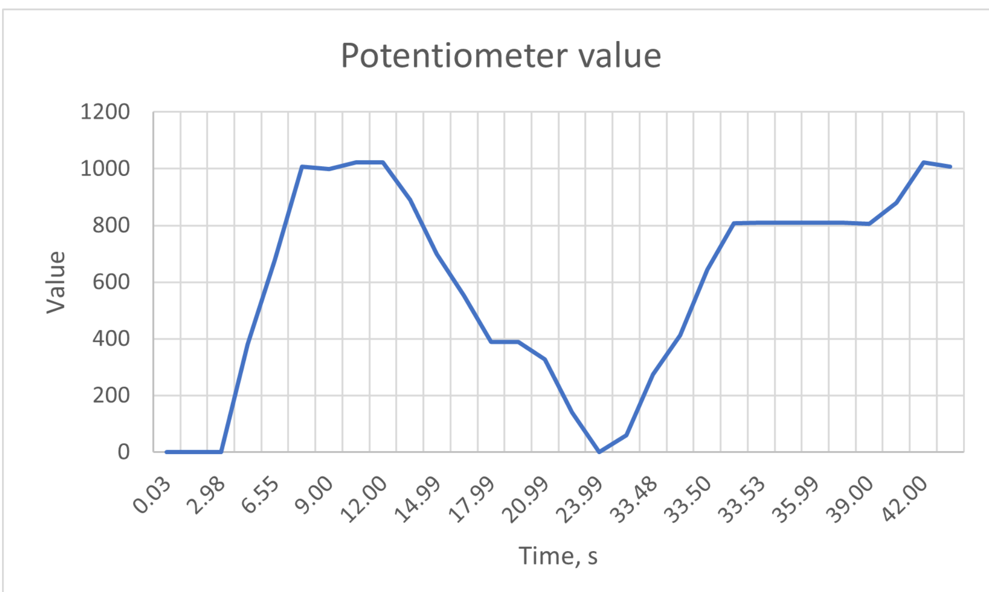
i) Potentiometer :

TIME	STARTED TIME	POTENTIOMETER VALUE
4:26:35 PM	0.03	0
4:26:37 PM	1.49	0
4:26:38 PM	2.98	0
4:26:40 PM	4.49	380
4:26:42 PM	6.55	679
4:26:43 PM	7.49	1007
4:26:44 PM	9.00	999
4:26:46 PM	10.48	1023
4:26:47 PM	12.00	1023
4:26:49 PM	13.49	890
4:26:50 PM	14.99	700
4:26:52 PM	16.48	552
4:26:53 PM	17.99	388
4:26:55 PM	19.48	389
4:26:56 PM	20.99	140
4:26:58 PM	22.50	0
4:26:59 PM	23.99	59
4:27:01 PM	25.50	274
4:27:01 PM	33.48	413
4:27:09 PM	33.48	644
4:27:09 PM	33.50	807

4:27:09 PM	33.51	810
4:27:09 PM	33.53	810
4:27:10 PM	34.50	810
4:27:11 PM	35.99	810
4:27:13 PM	37.99	810
4:27:14 PM	39.00	806
4:27:16 PM	40.50	880
4:27:17 PM	42.00	1023
4:27:19 PM	43.50	1007

Video's link for the real time data graph:

https://drive.google.com/file/d/13a7KFknTRLyGrQyBX2PZcMdOsInX50j-/view?usp=drivesdk



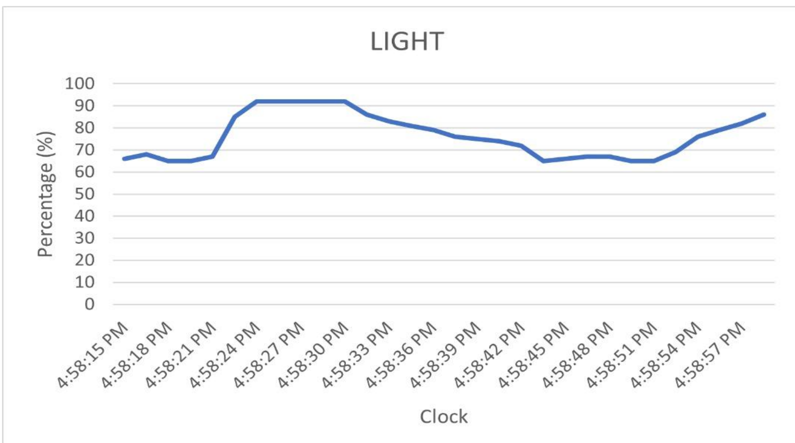
ii) LM35 & LDR

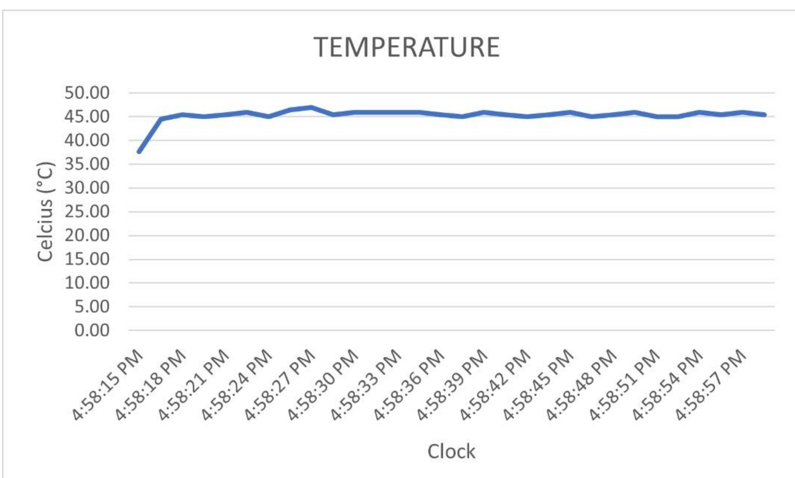
Clock	Temperature (℃)	Light (%)
4:58:15 PM	23.06	88
4:58:17 PM	31.85	87
4:58:18 PM	32.82	87
4:58:20 PM	32.82	87
4:58:21 PM	32.34	87
4:58:23 PM	32.34	86
4:58:24 PM	32.34	86
4:58:26 PM	32.82	87
4:58:27 PM	32.34	88
4:58:29 PM	32.34	87
4:58:30 PM	33.31	86
4:58:32 PM	33.80	86
4:58:33 PM	31.85	87
4:58:35 PM	32.34	87
4:58:36 PM	32.82	88
4:58:38 PM	32.34	92
4:58:39 PM	32.34	75
4:58:41 PM	32.82	69
4:58:42 PM	32.82	68
4:58:44 PM	32.34	57
4:58:45 PM	41.61	91
4:58:47 PM	42.10	90
4:58:48 PM	42.10	86

4:58:50 PM	42.10	88
4:58:51 PM	42.10	87
4:58:53 PM	39.17	69
4:58:54 PM	39.66	68
4:58:56 PM	43.07	87
4:58:57 PM	36.73	88
4:58:59 PM	35.75	87
4:59:00 PM	35.75	86

Video's link for the real time data graph:

https://drive.google.com/file/d/1cbZP6b_D7bDT0LXfHMpi2VLE9X1rNcyo/view?usp=drivesdk





Discussions

The Voltage Divider Circuit was used in our project to change the resistance value of the LDR dynamically in response to changes in the amount of light in the room. The constant changes shown on the serial monitor during the experiment showed that this adjustment had been made. This showed how sensitive the LDR was to its light surroundings. We used the PLX-DAQ software, which worked well with Excel to organize and store sensor data and make data collection and processing faster. The project combined basic ideas, like the Voltage Divider Circuit, to change the LDR's resistance flexibly based on the amount of light. The LM35 temperature monitor also helped by keeping track of changes in its steady voltage output that were caused by temperature, with a 10mV shift for every 1 degree Celsius change. PLX-DAQ software was used to carefully record and plot this temperature data as well as readings of the light level.

During the test, there were times when the recorded data wasn't correct, especially when reports of temperature in Celsius ranged from 60 - 120 degrees. After more research, it was found that the sensor's strange behavior was caused by bad connections and an unexpected component touching the breadboard. This interrupted the flow of current and ruined the output data. Taking care of these problems became necessary to make sure that our sensor reports were reliable and correct.

Conclusion

In conclusion, there are various applications that can be done by interfacing DAQ with a microcontroller. Also, it is really important to connect DAQ with a microcontroller(Arduino) to make the electronics smarter. In this report, we learn how to interface DAQ with Arduino and link the data with Excel so that we can tabulate and plot graphs for a better understanding of the result.

In this report, we create a circuit that contains potentiometers, Arduino, LM35, and LDR. Then we upload the code from the Arduino IDE to the microcontroller. By doing that, we enable Arduino to read analog signals from the LM35 and LDR, converting them into digital format. From that, we can distinguish how to store the results from all the sensors in Excel. After a few calculations and a discussion about the results and whether it's relevant or not, we agreed and were satisfied with the data and started plotting the graph in Excel.

In short, this lab report provides us with the importance of interfacing DAQ with the microcontroller. Also, it gave us a wide view of how people work with DAQ and microcontrollers at the industrial level and use this technology in different projects and applications.

Recommendations

One of the recommendations that we think really important to this lab report is to choose the appropriate hardware to use during the experiment. We found that it is much easier to use Arduino UNO R3 rather than Arduino MEGA due to unexplainable reasons.

Next, we strongly agreed that it is really important to double-check and make sure all of the sensors such as the potentiometer, LDR, and LM35 works perfectly because in certain circumstances the value or the output from the reading are quite weird because of the problems with sensors. For example, the value of LM35 is quite high even though we are at room temperature. But after replacing it with the new LM35, the results are normal.

Lastly, we highly recommend using the correct formula in order to calculate the results for the sensor reading. Make sure we use the formula to calculate the temperature in Celcius, not Kelvin or Fahrenheit. If we use the wrong formula, the result for our experiment might be quite different in terms of number and the graphs that we plot will have different patterns and shapes from the normal graphs.

References

1. *PLX-DAQ - Parallax*. (n.d.). Parallax. https://www.parallax.com/package/plx-daq/
2. Negm, I. (2018, June 18). *Quick Start to Simple DAQ System using PLX-DAQ Excel & Arduino.* Medium. Retrieved November 17, 2023, from https://inegm.medium.com/quick-start-to-simple-daq-system-using-plx-daq-excel-arduino-d2457773384b
3. Das, D. (2022, April 13). *How Does an LM35 Temperature Sensor Work and How to Interface it with Arduino?* Circuit Digest. Retrieved November 17, 2023, from https://circuitdigest.com/microcontroller-projects/interfacing-lm35-sensor-with-arduino

Student's Declaration

<u>Certificate of Originality and Authenticity</u>

This is to certify that we are responsible for the work submitted in this report, that the original work is our own except as specified in the references and acknowledgment, and that the original work contained herein has not been untaken or done by unspecified sources or persons.

We hereby certify that this report has not been done by only one individual and all of us have contributed to the report. The length of contribution to the reports by Each individual is noted within this certificate.

We also hereby certify that we have read and understand the content of the total report and no further improvement on the reports is needed from any of the individual contributor to the report.

We, therefore, agreed unanimously that this report shall be submitted for marking and this final printed report has been verified by us

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