REPORT 5: DAQ INTERFACING WITH MICROCONTROLLERS.

GROUP 4

MCTA 3203

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MECHATRONICS SYSTEM INTEGRATION

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INTRODUCTION

This project explores the interfacing of a simple DAQ system using microcontrollers specifically employing an Arduino board to collect environmental data from sensors. The aim is to demonstrate how microcontrollers can be figured out to acquire, process and transfer sensor data to a computer based application for visualisation and analysis. The focus of this experiment is on measuring two environmental parameters which is temperature and light intensity using an LM35 temperature sensor Light Dependent Resistor (LDR). The Arduino serves as the core processing unit, converting analog sensor signals into digital data and transmitting them to Microsoft Excel via the PLX-DAQ (Parallax Data Acquisition) interface. The hands-on setup not only reinforces fundamental skills in sensor interfacing and microcontroller programming but also offering foundational experience in integrating hardware and software for basic data monitoring tasks and practical applications of a real time data acquisition in mechatronic system integration.

ABSTRACT

The main purpose for this experiment is to show how to use an Arduino as a Data Acquisition (DAQ) device to connect to sensors and record data using Microsoft Excel's PLX-DAQ application. Temperature and light intensity were measured using an LM35 temperature sensor and a Light Dependent Resistor (LDR), respectively. Building a sensor circuit, configuring the Arduino to read sensor data, and moving the gathered data to a computer for real-time analysis and visualisation were all part of the project. The effective hardware-software interface demonstrated that Arduino may be used as an inexpensive DAQ solution for simple sensor data collecting. The main conclusions demonstrated that the Arduino does successfully record and send sensor data, and Excel also successfully presents it for additional examination. Moreover, this practical setup proved the hypothesis that microcontrollers like Arduino can reliably interface with DAQ systems for simple measurement and monitoring applications.

MATERIALS AND EQUIPMENT

- Arduino Board (e.g., Arduino Uno)
- PLX-DAQ Add-in Software (for Microsoft Excel)
- Light Dependent Resistor (LDR)
- Jumper Wires
- Breadboard
- Resistors
- PC
- LM35 Temperature Sensor

EXPERIMENTAL SETUP

1. Construct a simple circuit shown in Fig.2.

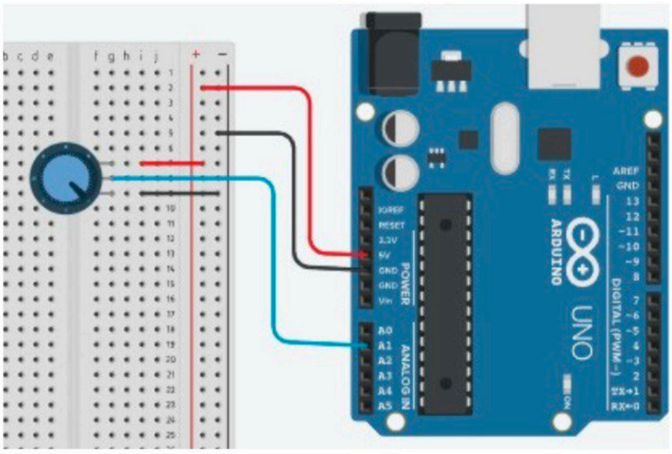


FIGURE 2

2. Launch the Arduino IDE and type and verify the example code shown below.
3. Download and install the PLX-DAQ.

4. Launch it and there should be an Excel spreadsheet with a pop-out GUI window in the folder as shown below.

5. In the GUI, select the correct com port number and ensure the baud rate is the same as the one written in the code.

6. Once done, press the connect tab and the data from the Arduino will be displayed in the spreadsheet.

7. Observe the received data and use all tools available in the MS Excel for analysis

8. After constructing the circuit like Fig. 3, launch Arduino IDE and write code that allows Arduino to read analog signals from the LM35 and LDR and convert it to digital.

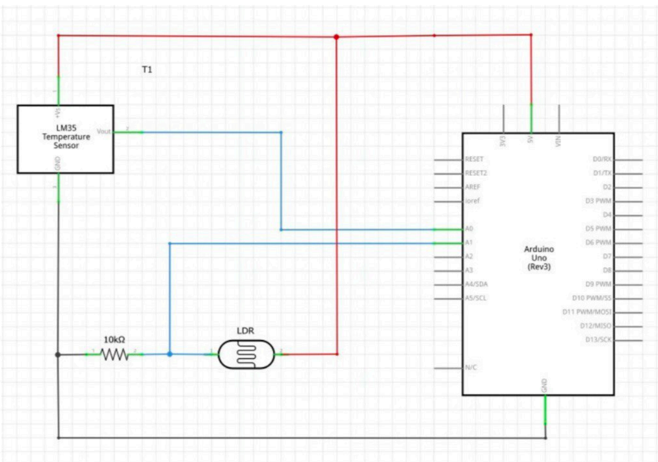


FIGURE 3

9. Complete the code.

10. Verify the code and upload it to the Arduino board.

11. Launch the PLX-DAQ spreadsheet. Ensure correct com port is selected and generate the output from the sensors in the spreadsheet.

METHODOLOGY

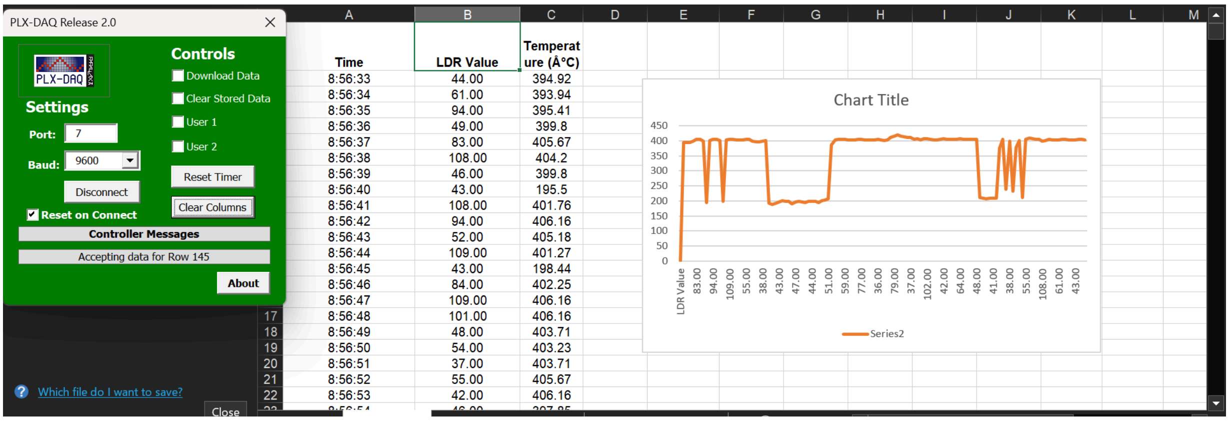
1. Circuit Construction:
   -Built the sensor circuit by connecting the LDR and LM35 temperature sensor to an Arduino board using a breadboard and jumper wires.
   -A resistor was connected in series with the LDR to form a voltage divider circuit.

2. Arduino Programming:
   -Launched the Arduino IDE and wrote code to read analog signals from both the LM35 and LDR sensors.
   -Converted the analog signals to digital format using Arduino's Analog-to-Digital Converter (ADC).
   -Programmed the Arduino to send the sensor readings through serial communication.

3. Data Acquisition Setup:
   -Downloaded and installed the PLX-DAQ add-in for Microsoft Excel.
   -Launched the PLX-DAQ GUI and selected the correct COM port and baud rate matching the Arduino program.
   -Connected the Arduino to the PLX-DAQ interface.

4. Data Collection and Analysis:
   -Observed real-time sensor data logging into the Excel spreadsheet.
   -Used Excel tools to plot the recorded data for analysis and interpretation.
   -Commented on the code to explain the function of each section and ensure clarity.

RESULTS




```
void setup() {
  Serial.begin(9600);  // Start serial communication
  Serial.println("CLEARDATA");  // Clear previous data
  Serial.println("LABEL,Time,LDR Value,Temperature (°C)");  // Excel headers
}

void loop() {
  // Read LDR value from A0
  int ldrValue = analogRead(A0);

  // Read LM35 value from A1
  int lm35Value = analogRead(A1);
  float voltage = lm35Value * (5.0 / 1023.0);      // Convert to voltage
  float temperatureC = voltage * 100;              // Convert to °C

  // Send to PLX-DAQ
  Serial.print("DATA,TIME,");
  Serial.print(ldrValue);
  Serial.print(",");
  Serial.println(temperatureC);

  delay(1000);  // 1-second delay
}
```

This reads temperature and LDR value and returns it to the PLX-DAQ software for real-time visualization in Excel. The analog reading of the LM35 temperature sensor is read at pin A0, converted to millivolts and then degrees Celsius. Likewise, the light intensity from the LDR is read at pin A1 and converted to a percentage (0–100%). These values are then sent to the Serial Monitor in PLX-DAQ-compatible form, including column headers ("Time," "LDR Value," "Temperature (℃)"). The loop runs every 1.5 seconds, making the data current.

DISCUSSION

This experiment proves the operation of a basic data acquisition (DAQ) system for real-time temperature and light intensity measurement. Arduino microcontroller, LM35 temperature sensor, and an LDR (Light Dependent Resistor) were employed to sense environmental parameters, process, and store them into PLX-DAQ to be graphically represented in Microsoft Excel.

Challenges Encountered:
- Noise and Signal Stability:
Signals of the LM35 and LDR were occasionally contaminated by variations, likely due to electrical noise or environmental interference. The issue can be addressed by signal filtering or averaging techniques.

- Resolution Limitation:
Arduino's 10-bit ADC resolution constrained the sensor measurement accuracy, especially for temperature readings. More precise ADCs with higher resolution or utilization of external conditioning circuits would enhance measurement accuracy.

CONCLUSION

All in all, the experiment really effectively illustrated how an Arduino and sensors-based DAQ system may be interfaced with a computer-based data recording tool (PLX-DAQ). For monitoring and analysis, the Arduino accurately transferred real-time analogue data from the LDR and LM35 sensors to Excel. The findings lend credence to the idea that microcontrollers can function well as straightforward, reasonably priced DAQ systems. Furthermore, this configuration offers an accessible method of monitoring several physical characteristics for research, prototyping, and industrial monitoring purposes, and it serves as a useful basis for more intricate data gathering duties in mechatronics and automation applications.

RECOMMENDATION

The recommendations that can be made to improve the performance and reliability of this experiment is by implementing signal filtering techniques. Electrical noise affecting the sensor readings could be reduced by incorporating the hardware based filtering for example capacitors or software base averaging methods in the Arduino core to produce more stable data. Higher resolution ADCs also can be used since Arduino's 10 bit analog to digital converter (ADC) limits the measurement precision. By using a microcontroller or external ADC module with higher resolution like 12 bit or 16 bit would enhance the data accuracy. The next recommendation is improving the sensor calibration. The raw sensor outputs may not be entirely accurate due to device tolerances. In this case, we can perform calibration by comparing the LM35 and LDR sensors before data acquisition to improve the measurement accuracy and ensure more reliable results. In summary, by implementing these recommendations, the overall accuracy and stability of the DAQ system can be significantly enhanced.

ACKNOWLEDGEMENTS

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STUDENT'S DECLARATION

Certificate of Originality and Authenticity

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 acknowledgement, and that the original work contained herein have 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's contributors 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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