MECHATRONICS SYSTEM INTEGRATION

EXPERIMENT 5:
DAQ INTERFACING WITH MICROCONTROLLER

GROUP NUMBER: A

PROGRAMME: MECHATRONICS

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Abstract

This experiment involved ‘Data Acquisition’ (DAQ) interfacing with a microcontroller (Arduino) and the sensors (LDR, LM35). It is used to process data from sensors to computers for analysis with the help of add-in-designed software. The output from LDR which detects the light and LM35 which detects the temperature were sent to the computer into ‘Parallax Data Acquisition’ (PLX-DAQ), as software for Microsoft Excel to store the output from both sensors through Arduino. The purpose was to see the value measured from both sensors by interfacing. One of the pins of LM35 and LDR was connected to the analog pin (A0 and A1) in Arduino which allowed and enabled data reading using coding in Arduino which later interacted with the PLX-DAQ. The outcome was that the LDR measured the value of 0 to 1023 and the LM35 measured the value of 0 up to 100 degree Celsius and the outputs were organized into Microsoft Excel. Interfacing was beneficial in communicating between components to obtain desired output where one of them was the output from sensors that could not be seen directly but could, upon interfacing it with Arduino.

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Objectives

1. Interface LM35 and LDR sensors with Arduino for data acquisition.
2. Process sensor data using Arduino and transmit it to PLX-DAQ.
3. Highlight LM35's precision in temperature measurement, offering a direct correlation between voltage and ambient temperature.

Introduction

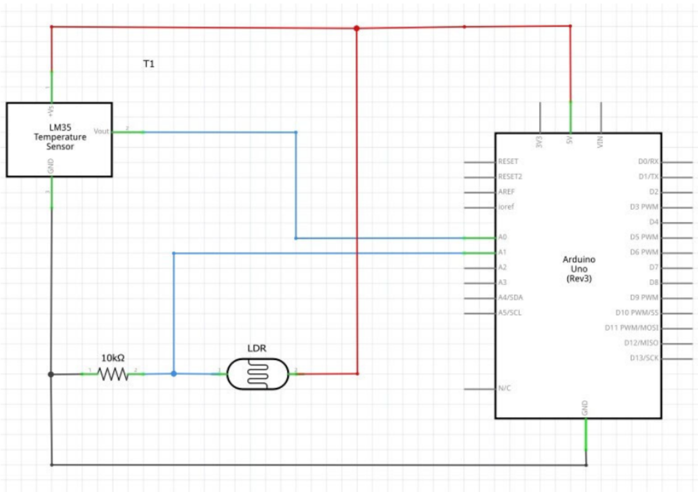
In the realm of data acquisition and sensor-based experimentation, the integration of Arduino as a simple Data Acquisition (DAQ) device provides an accessible and versatile platform for capturing environmental parameters. This experiment employs the LM35 temperature sensor and the Light Dependent Resistor (LDR) in conjunction with a 10kohm resistor, interfaced with Arduino, to gather real-time data. The LM35 operates on the principle of temperature-dependent voltage across a diode, while the LDR serves to detect variations in light intensity. The collected data is then transmitted to PLX-DAQ, facilitating data logging and analysis. Additionally, the experiment explores the dynamic control of light intensity by manipulating the LDR's exposure to light or darkness, with the resulting readings displayed on the Arduino's serial monitor.

Material and Equipment

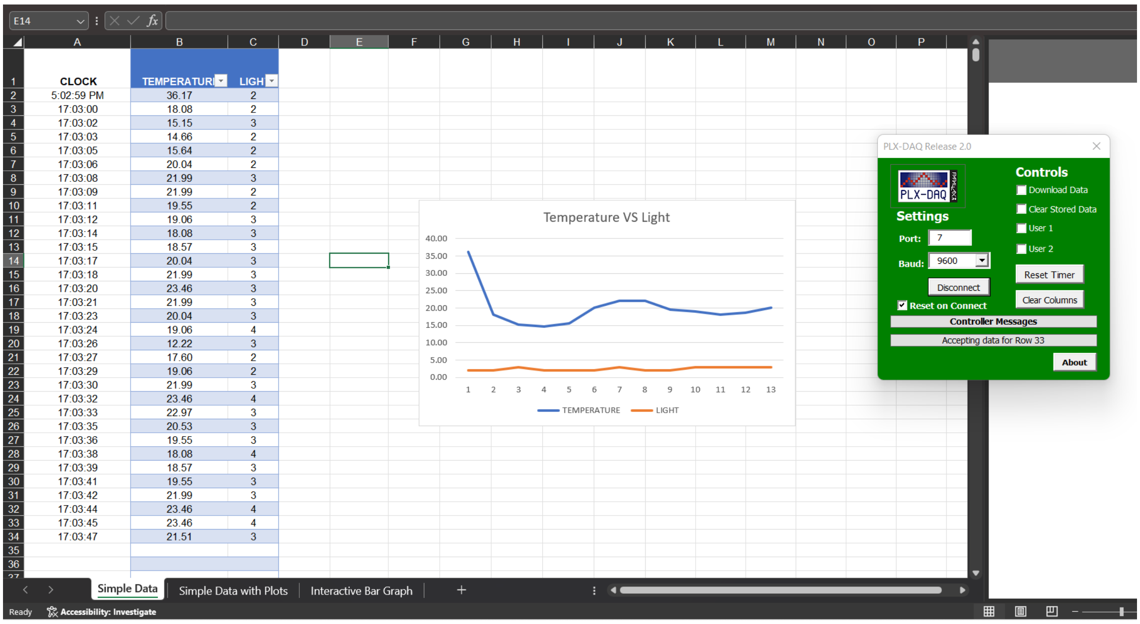
- PLX-DAQ
- Arduino Board
- LDR
- LM35
- Jumper Wires
- Resistor
- Breadboard

Experimental Setup

The setup begins by constructing a circuit designed to collect data from sensors using an Arduino as a DAQ (data acquisition device). The components that were used included a LM35 (temperature sensor), an LDR (light-dependent resistor) , an Arduino UNO board, some jumper wires, a resistor, and a breadboard. The LM35 is connected to the Arduino to measure temperature, while the LDR is used for capturing light intensity.



After carefully connecting the components according to the provided circuit diagram, the next step is to program the Arduino using the Arduino IDE. When uploaded to an Arduino board connected to an LM35 temperature sensor and an LDR, this code will enable the Arduino to continuously read analog signals from these sensors. The analog values from these sensors are converted to digital values, and these values are sent to the PLX-DAQ tool. PLX-DAQ logs and visualizes the data in real time in an Excel spreadsheet.



Methodology

In this experiment, we used Parallax Data Acquisition (PLX-DAQ) to collect data from a sensor which is LM35 and LDR for analysis when displayed in the form of an Excel spreadsheet. When PLX-DAQ is launched, there will be an Excel spreadsheet and pop-out GUI window as below

```
//int lm = A0;
//int ldr = A1;
float lm_value;
float tempcelc;
int ldr_value;
int ldr_percent;

void setup()
{
  Serial.begin(9600);
  Serial.println("CLEARDATA");
  Serial.println("LABEL, CLOCK, TEMPERATURE, LIGHT");
}
```

```
void loop()
{
  lm_value = analogRead(A0);
  tempcelc = (lm_value/1023)*5000;
  tempcelc = tempcelc/10;

  ldr_value = analogRead(A1);
  ldr_percent = map(ldr_value,0,1023,0,100);

  Serial.print("DATA,TIME,");
  Serial.print(tempcelc);
  Serial.print(",");
  Serial.println(ldr_percent);
  delay(1500);
}
```

Commented lines: These lines are commented out, meaning they are not active in the code. They suggest the possibility of assigning pin numbers to LM35 and LDR but are not currently utilized.

Variable Decleration: These lines declare four variables to store sensor readings and processed data. lm_value holds the raw reading from the LM35, tempcelc stores the converted temperature, ldr_value holds the raw reading from the LDR, and ldr_percent represents the light intensity as a percentage.

Setup function: In the setup function, serial communication is initiated at a baud rate of 9600. It sends commands to clear any existing data in PLX-DAQ and prints labels for the data columns: "CLOCK," "TEMPERATURE," and "LIGHT."

Loop function: The loop function reads analog values from the LM35 and LDR sensors. It converts the LM35 reading to temperature in Celsius and maps the LDR reading to a percentage. The data is then printed to the serial monitor in PLX-DAQ format with a time stamp. The delay(1500) introduces a 1.5-second delay before the next iteration.

Data Collection

In this experiment, data collection is done by the Arduino board, which reads analog signals from the LM35 temperature sensor and the LDR (Light Dependent Resistor). The data collected includes the temperature reading from the LM35 sensor and the light intensity reading from the LDR. The Arduino reads the analog signal from the LM35 using the analogRead(LM35_pin) function, where LM35_pin is the analog pin to which the LM35 is connected. It also reads the analog signal from the LDR using the analogRead(LDR_pin) function, where LDR_pin is the analog pin to which the LDR is connected. The PLX-DAQ is used as a tool for data logging and for visualization in an Excel spreadsheet.

Data Analysis

We have used an LDR and LM35 as our sensors for this experiment. The sensors were supposed to make contact with what we wanted to measure either directly or indirectly. Arduino as the chosen DAQ device will collect the data from the sensors and then send the information to the PLX-DAQ to simplify data collection and data analysis using real-time monitoring. Using this software, we can observe that the collected data from Arduino are easy to access and manage. For this experiment, we have collected the temperature and light data using both sensors. The acquired data can be used to build useful charts in Excel. For the LM35 temperature sensor, we can plot a graph of temperature readings over time. From the data, we could observe the variations in temperature data. For the LDR light sensor, we can plot a graph of light data over time. From the plotted graph, it displays how the light intensity will change with the increase of time.

Result

The data from sensors are successfully collected by the Arduino. The data were transferred to PLX-DAQ for data logging and analysis. The circuit was successfully constructed and the code written was successfully executed without much error. In summary, the experiment successfully collected, logged, and analyzed data using PLX-DAQ, Arduino, LM35, and LDR, providing significant insights into temperature and light fluctuations over time. The PLX-DAQ user interface provided efficient data administration and analysis, increasing the entire experiment's effectiveness.

Discussion

- **Arduino UNO**

Arduino is used as a DAQ device, serving as the connection between computers and sensors. It can be connected to the computer through USB slots on the computer. It receives analog signals from the sensors and changes them into digital signals that the computer can understand.

- **Sensor**

In this experiment two sensors are used, LM35 and LDR. LM35 is an analog temperature sensor that is used to sense the room temperature. LDR stands for 'Light Dependent Resistor' also known as photoresistor whose resistance changes based on the amount of light falling on it. The received light value was subsequently scaled from 0 to 100 for display.

- **Parallax Data Acquisition**

This tool simplifies the analysis of data collected in various settings, including field measurements, sensor experiments, and real-time equipment monitoring, by making it easily accessible and manageable within Excel spreadsheets

Conclusion

In conclusion, this experiment successfully employs Arduino as a data acquisition tool to gather real-time data from an LM35 temperature sensor and an LDR. By converting raw sensor readings into meaningful values, the experiment demonstrates the practical use of Arduino in environmental monitoring. The integration with PLX-DAQ streamlines data logging and analysis, providing a user-friendly platform for further interpretation in Excel. The experiment's straightforward approach and ability to manipulate environmental conditions make it a valuable learning experience for sensor interfacing with Arduino.

Recommendation

The need for improvement is always needed to ensure the accuracy, reliability, and adaptability of the experiment results. Researchers can enhance their techniques and cut down on possible error sources through continuous improvement. The findings become more reliable as a result, yielding more exact and accurate outcomes. Below are a few recommendations that we can improve in the future:

1. **Testing and calibration:** In the future, we should ensure that the sensor is calibrated properly in the experiment so that the sensor data is more accurate. Testing and calibration are also important to maintain and improve the reliability of the system and its results.

2. **Equipment protection:** To protect against overloads and short circuits, we should properly construct circuits. We should use more resistors and the correct value of the resistor to reduce the probability of the equipment burning or being damaged. This helps to keep electrical equipment and wiring in good working order.

3. **Environmental condition:** During the experiment, we should control and monitor ambient conditions such as the temperature and the light of the surroundings. This is because some sensors are sensitive to environmental changes, and these changes can have an impact on their accuracy.

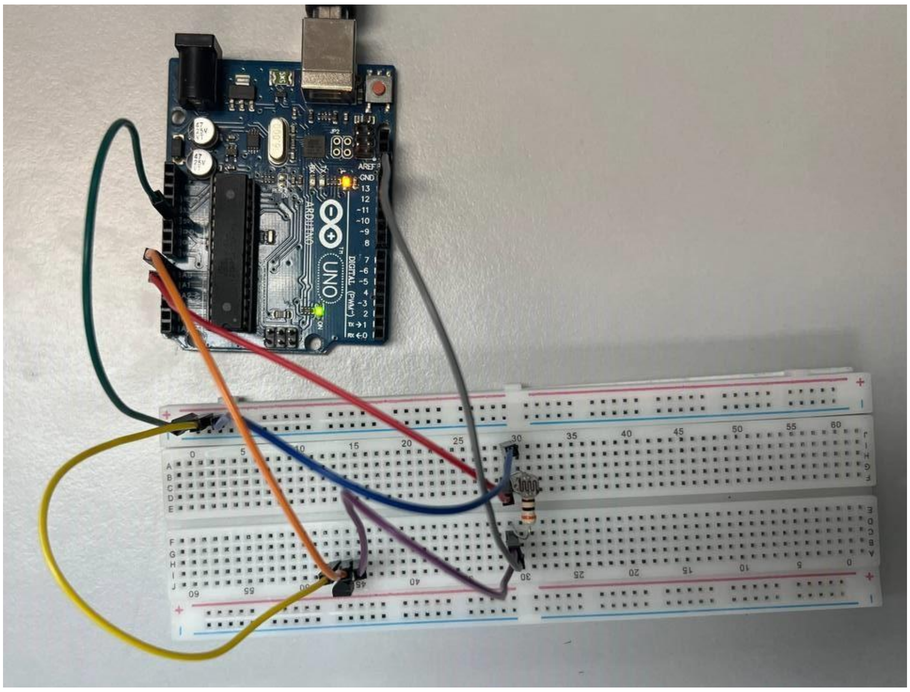
We can increase system reliability and efficiency by implementing these recommendations. As a result, it will limit the number of errors that may arise in the future.

References

Liu, C., Ren, W., Zhang, B., & Lv, C. (2011). *The application of soil temperature measurement by LM35 temperature sensors.*

Zulkifli. (2014). *Mechatronics Interfacing Lab Manual*, (Rev. ed.). Unpublished Class Materials

Appendices



The final circuit for the task given

Acknowledgments

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Our fellow group members also deserve special acknowledgment for their collaboration and support. Our discussions, knowledge-sharing, and problem-solving sessions greatly enriched our understanding of this experiment's concepts and enhanced the overall learning experience. The collective contributions of our group members have not only enriched our learning experience but have also significantly contributed to the successful completion of this project.

<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 **read** and **understand** the content of the report and no further improvement on the report is needed from any of the individual's contributions 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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Contribution	- Intro - Experiment Setup - Conclusion	**Agree** ✅

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Contribution	-Data Analysis -Recommendation	**Agree** ✅

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