LABORATORY PROJECT REPORT

DAQ interfacing with Microcontrollers

EXPERIMENT 6

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Table of Contents

1.0 Introduction

The ability to accurately collect, process, and analyze data from physical systems is vital for monitoring, control, and automation.One of the key methods used for this purpose is Data Acquisition (DAQ).It involves capturing electrical or physical signals from the real world and converting them into a digital format that can be analyzed by a computer.

This report explores the concept of DAQ interfacing with microcontrollers,with a specific focus on using the Arduino platform as a simple and cost-effective DAQ device.The experiment involves constructing circuits that utilize an LM35 temperature sensor and a Light Dependent Resistor (LDR) to measure environmental conditions.These sensors convert physical parameters such as light intensity and temperature and turn it into analog electrical signals.The Arduino board then reads these signals, converts them into digital data, and transmits the results to a computer system in the form of an Microsoft Excel spreadsheet file.

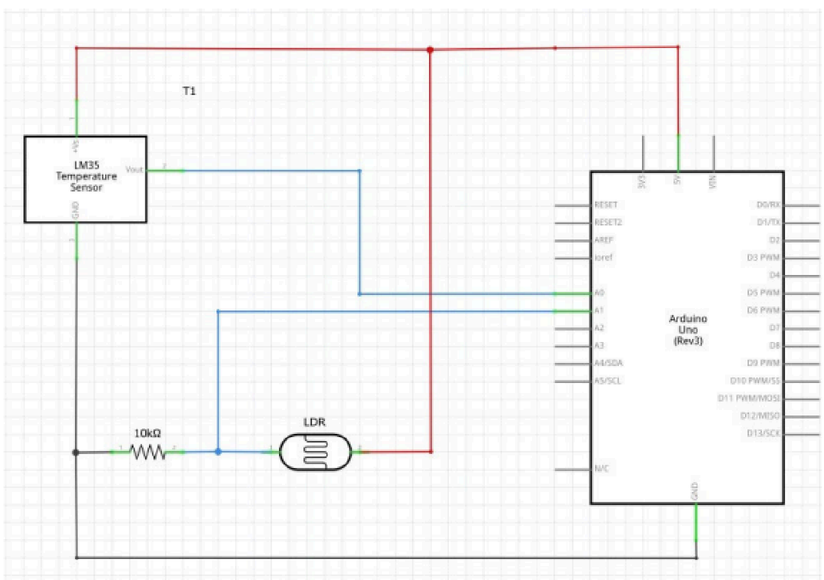
Data logging and analysis are performed using PLX-DAQ, a Microsoft Excel add-in that enables real-time data display and processing within spreadsheet format. By integrating hardware components with software tools,this experiment provides practical experience in setting up a functional DAQ system, understanding sensor behavior, writing and analyzing Arduino code, and generating meaningful data visualizations. The hands-on approach not only reinforces theoretical concepts but also demonstrates how microcontrollers can be effectively used in real-world data acquisition and monitoring applications.

2.0 Materials and Equipments

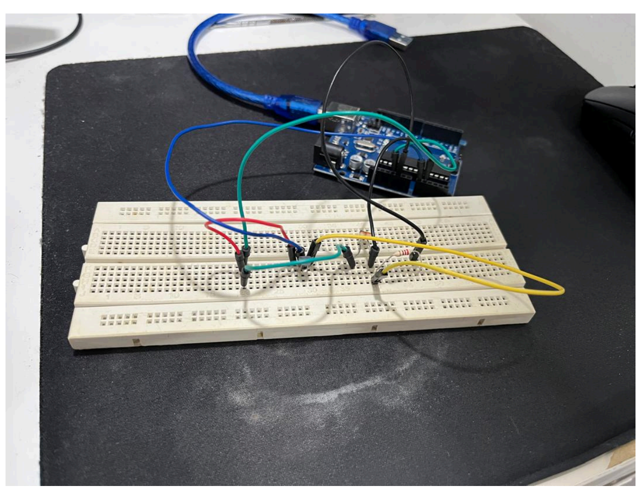
- PLX-DAQ
- Arduino Board
- LDR
- LM35
- Jumper Wires
- Resistor
- Breadboard

3.0 Experimental Setup

3.1 Diagram Setups



3.2 Circuit Setup



4.0 Methodology

4.1 Hardware Setup

Two types of analog sensors were used which are a LM35 temperature sensor and a Light Dependent Resistor (LDR).
The LM35 was connected to measure ambient temperature, while the LDR was used to detect light intensity.Both sensors were wired to analog input pins on the Arduino board. Necessary components such as jumper wires and resistors were used to complete the circuit and ensure proper voltage division and signal conditioning. The output from each sensor was connected to separate analog pins A0 and A1 of the Arduino.

4.2 Software Configuration

The PLX-DAQ add-in was installed on Microsoft Excel to enable serial communication between the Arduino and the computer.This software was configured to recognize the correct COM port and baud rate,ensuring seamless real-time data transmission from the Arduino to the spreadsheet.

4.3 Data Transferred

As the Arduino collects data, it sends the values of the data to the Excel spreadsheet where the PLX-DAQ tool records and organizes them into rows and columns with timestamps. This enabled real-time monitoring and data logging of both temperature and light intensity.

5.0 Results

The experiment successfully demonstrated a basic yet effective data acquisition system using the Arduino board to interface with two analog sensors—LM35 for temperature measurement and an LDR for ambient light detection. Real-time analog signals from both sensors were digitized by the Arduino's ADC and transmitted over a serial connection to Microsoft Excel via the PLX-DAQ interface.

Throughout the execution, the Arduino accurately read voltage outputs from the LM35 and LDR sensors, converting the LM35 data into temperature readings in degrees Celsius and scaling the LDR values into percentage-based light intensity. The data was transmitted using a baud rate of 9600, ensuring stable and continuous communication between the Arduino and the computer.

As data was streamed, the PLX-DAQ add-in successfully captured and organized the values into an Excel spreadsheet with labeled columns for timestamp, temperature, and light level. The update interval of 1.5 seconds provided a clear and smooth representation of sensor trends over time. The temperature readings showed consistent values corresponding to room temperature with slight variation due to environmental changes, while the light intensity values responded accurately to fluctuations in ambient lighting conditions (e.g., shading the LDR or increasing illumination).

Several meaningful plots were generated in Excel to visualize the trends in sensor readings. A time-series graph of temperature indicated a relatively stable environment, while the light intensity plot demonstrated responsiveness to real-time changes, validating the effectiveness of the LDR setup.

Overall, the results confirmed the successful integration of LM35 and LDR sensors with the Arduino and PLX-DAQ system. The experiment effectively showcased the practical application of microcontroller-based data acquisition and real-time sensor monitoring, laying the foundation for more complex measurement and control systems.

6.0 Discussion

This experiment successfully demonstrated a basic sensor monitoring system using the LM35 temperature sensor and LDR light sensor interfaced with an Arduino and visualized in real time through the PLX-DAQ add-in for Microsoft Excel. By acquiring analog signals from both sensors and transmitting the data over serial communication, the system was able to log environmental temperature and light intensity with consistent accuracy.

The Arduino effectively handled analog-to-digital conversion, converting LM35 voltage readings into temperature values in degrees Celsius and scaling raw LDR readings into percentages representing ambient light levels. The data was streamed to Excel using a serial baud rate of 9600, where PLX-DAQ organized the values in a structured spreadsheet. This enabled real-time observation and analysis of how sensor readings changed in response to variations in the surrounding environment.

The system responded reliably to both temperature and lighting changes. For instance, shading the LDR caused an immediate drop in percentage light readings, while slight increases in surrounding heat sources reflected stable rises in temperature. The plotted data in Excel clearly visualized these trends, making it easy to interpret how the environment changed over time.

Some challenges encountered during the experiment included occasional noise in sensor readings, especially with the LDR. This is likely due to minor fluctuations in ambient lighting or sensor sensitivity. In future iterations, the addition of smoothing filters (e.g., moving average) could help stabilize the readings. Ensuring consistent sensor placement and avoiding sudden shadows or reflections also improved the accuracy and repeatability of the results.

Overall, this experiment was a strong introduction to the fundamentals of data acquisition and serial communication. It demonstrated how embedded systems can interact with PC-based tools like Excel for visualization, data logging, and analysis. The approach is extendable to more complex monitoring systems in applications such as environmental sensing, smart homes, and industrial condition monitoring.

7.0 Conclusion

To conclude this experiment, we successfully developed a basic data acquisition system using the LM35 temperature sensor and LDR light sensor interfaced with an Arduino board and visualized in real-time via PLX-DAQ in Microsoft Excel. By continuously capturing analog data from both sensors and transmitting it through serial communication, we were able to observe and analyze environmental temperature and light intensity with ease and clarity.

This project reinforced fundamental embedded systems concepts, including analog signal reading, ADC conversion, serial data transmission, and real-time data logging. The consistent performance of the system in responding to environmental changes validated the accuracy of sensor readings and the robustness of the Arduino-PLX-DAQ integration.

Furthermore, the experiment serves as a foundational step toward more sophisticated sensing applications. Potential extensions include multi-sensor data fusion, automated threshold-based alert systems, or integration with cloud-based data platforms for remote monitoring. Overall, the experiment effectively demonstrated the practicality and scalability of using Arduino for real-time environmental monitoring and data analysis.

8.0 Recommendations

To enhance the reliability and usability of the sensor-based data acquisition system, several improvements can be considered for future iterations of this experiment. One of the first steps would be to modularize the Arduino code using custom functions. This would help organize repetitive tasks such as analog reading and data formatting, making the code cleaner, easier to maintain, and simpler to expand.

During development and testing, it is highly recommended to make better use of Serial Monitor for debugging. Observing raw sensor values in real time can help identify unexpected readings or communication delays, especially when working with older or sensitive analog components.

Another key consideration is the condition of the sensors and hardware setup. Since the LM35 and LDR sensors used may be older or have undergone wear from previous use, their readings might not reflect precise or real-time environmental values. To improve accuracy, future work should consider using calibrated or newer sensor models, or implementing software-based filtering (e.g., moving averages or low-pass filters) to stabilize fluctuating values.Ensuring firm and secure connections on the breadboard can also eliminate common issues caused by loose jumper wires or intermittent contact. Even minor inconsistencies in wiring can lead to misleading sensor output and data logging errors.

Finally, exploring wireless communication options such as Bluetooth or WiFi modules can significantly enhance system flexibility. This would remove the dependency on USB cables and enable applications such as portable environmental monitors or IoT-based sensor networks.With these enhancements, the current system has strong potential to evolve into a more robust, responsive, and versatile data acquisition platform for educational and practical applications alike.

9.0 References

https://www.parallax.com/package/plx-daq/

Weekly Module - Google Drive. (n.d.). Google Drive. Weekly Module

10.0 Acknowledgement

Special thanks to Dr. Wahju Sediono and Dr. Zulkifli Bin Zainal Abidin, as well as the teaching assistants and peers, for their guidance and support in completing this experiment.

11.0 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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