Assignment 2

Dew Point Generator Controller and Sensor Data Logger for Climate Modelling of Tropical Plants

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Contents

List of Figures

List of Tables

Intro

This report documents the design and implementation of an embedded system developed to serve as both a scientific data logger and a smart interface with an analogue dew point generator. The system utilizes the RP2040 microcontroller and various sensors, including SDI-12 environmental sensors and a load cell, to collect and process data for use in climate modelling applications. The project aims to provide a reliable and efficient solution for monitoring and controlling environmental parameters, particularly in the context of research on tropical plant behavior under varying climate conditions. Specifically, the effects of CO2 on the growth of tropical plants under varying humidity conditions.

The need for accurate and continuous monitoring of environmental parameters in tropical plant research is critical. Traditional manual data collection methods are labor-intensive and error-prone, while physical presence in climate-controlled rooms can interfere with experiments by altering the internal environment. Additionally, existing commercial solutions, such as those offered by Campbell Scientific, are often expensive and rely on closed-source technology, limiting accessibility and customizability for researchers. This project addresses these challenges by creating an embedded system capable of interfacing with various sensors and providing real-time data logging and remote control capabilities at a lower cost. The system also serves as a smart controller for a dew point generator, enabling researchers to simulate different climate conditions and monitor plant responses from outside the controlled environment. By offering an open-source, affordable alternative, this project aims to fill a gap in the market, providing researchers with a versatile tool for their experiments without compromising on performance or flexibility.

Digital to analogue conversion and PWM Background (only a couple of sentences) Big Q did stuff on this

(explanation of the dew point generator and how it functions and why it is important for ensuring there isnt any condensation or something like that)

The LI-610 Dew Point Generator is a precision instrument designed to produce a stable stream of gas with a precisely controlled dew point. It uses Peltier thermoelectric coolers to regulate the temperature of water reservoirs, ensuring the air stream is fully saturated with water vapor. This precise control of dew point is critical in environmental research, as it helps prevent condensation inside climate-controlled chambers, which could disrupt experimental conditions and data accuracy.

Feature Demonstration

alsdkjfhasdlkdfjh

Components

Feel free to move and change the name of this subsection later

As seen in fig. 1 there were lots of blocks

Sensors

SDI-12

we used the `uart_break()` function to send the break signal, and then used the `uart_read_stuff()`

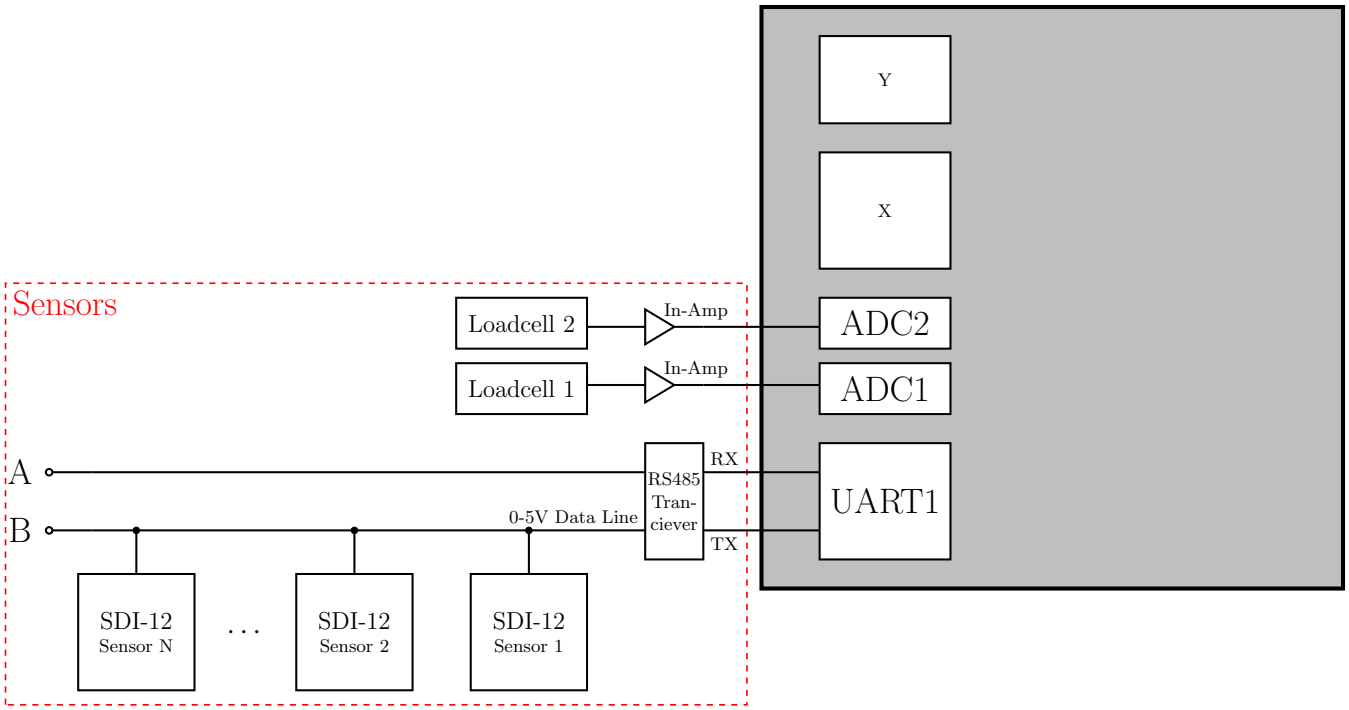

Fig. 1. Block diagram of the system

function to read the response from the sensor. The response was then parsed to get the data. The timing of the SDI-12 protocol is shown in fig. 2.

Load Cell (MT603) analogue signal, therefore requires ADC?

Sap Flow Sensor (SF5) uses SDI-12

Leaf thermistor uses SDI-12

Things to check:

- is 12V necessary?
- should we choose I2C or SPI (or both) as interface between RP2040 and DAC?
- do we want bluetooth or wifi?

- crystal like in assignment 1? - ADC for load cell?

Discussion

We discuss.

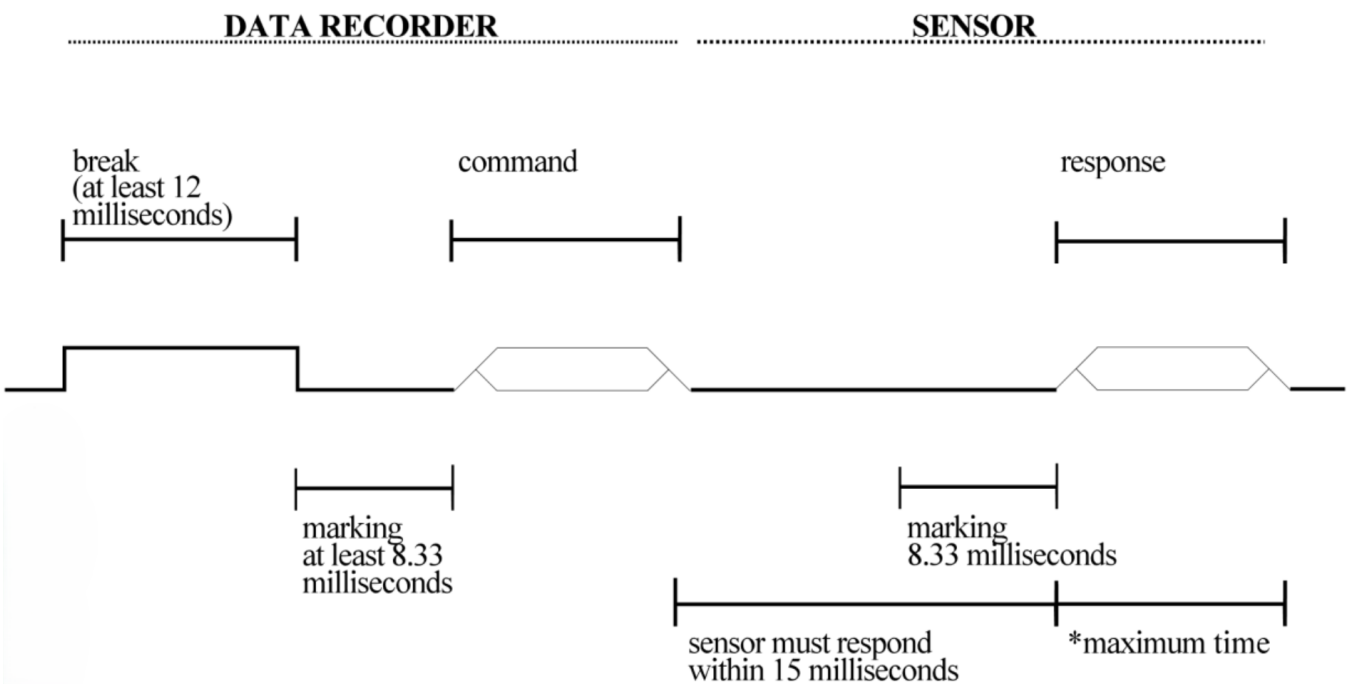

Fig. 2. SDI-12 timing from SDI-12 Support Group (2019)

Conclusion

We conclude.

Appendix

References

SDI-12 Support Group, *SDI-12: A Serial-Digital Interface Standard for Microprocessor-Based Sensors*, SDI-12 Support Group, River Heights, Utah, Jan. 2019, version 1.4. [Online]. Available: http://www.sdi-12.org