Smart Greenhouse Watering System

B.Sc. (Honours) in Applied Physics and Instrumentation

Department of Physical Sciences

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Project Description

Background

The constant monitoring of plant conditions is important for crop development and automated systems guarantee favourable conditions for the plants at all times. A smart system can increase crop yield and reduce the need for human interaction, thus creating a more profitable system. Sensors can be used to monitor a large range of parameters to specialise the system for any crop as needed.

In recent years there have been a number of severe weather events in the country, such as droughts, floods, and heatwaves. Future climate change will likely exacerbate this problem. The growing importance of irrigation in the future will increase the need for automated systems and smart watering systems.

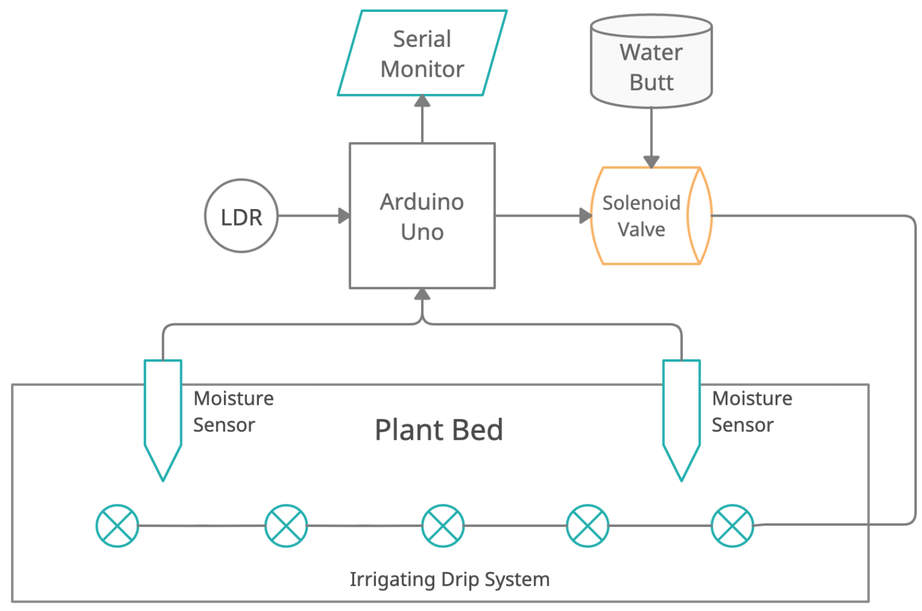
The aim of this project was to create a smart watering system to monitor and control plant conditions in a greenhouse.

The objectives of this project were to:

- Monitor daylight conditions and prevent watering plants in darkness
- Monitor soil moisture levels to a preferred level
- Control a solenoid valve to maintain moisture levels in the soil

System Design

The build itself consists of an Arduino Uno with three analog inputs: one light dependent resistor and two soil moisture sensors. The Arduino then outputs a signal to the solenoid valve, and when connected to a computer, outputs messages to the Arduino serial monitor. The solenoid valve is gravity fed by a water butt which leads into a drip irrigation system.



Proposed Solution

Components Required

Data Acquisition Device

- Arduino Uno Rev3

Hardware

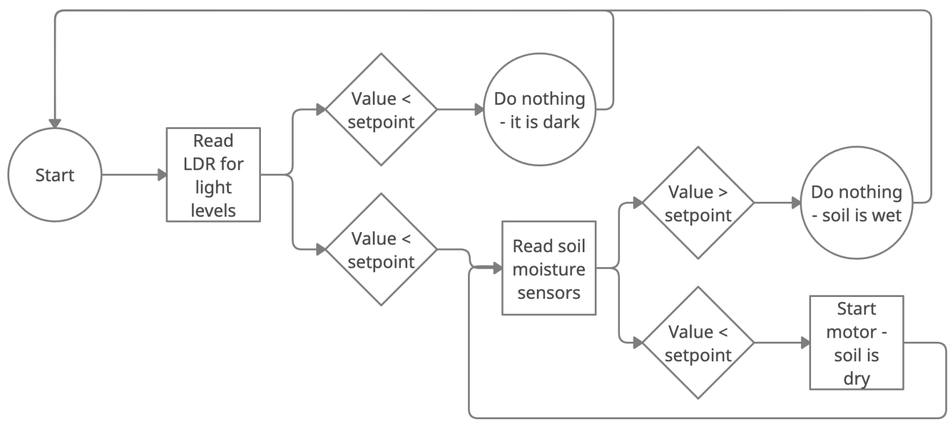
- 2x Soil Moisture Sensors
- Solenoid Valve
- Water Butt Supply
- Drip Irrigation System

Software

- Arduino IDE

Arduino Program

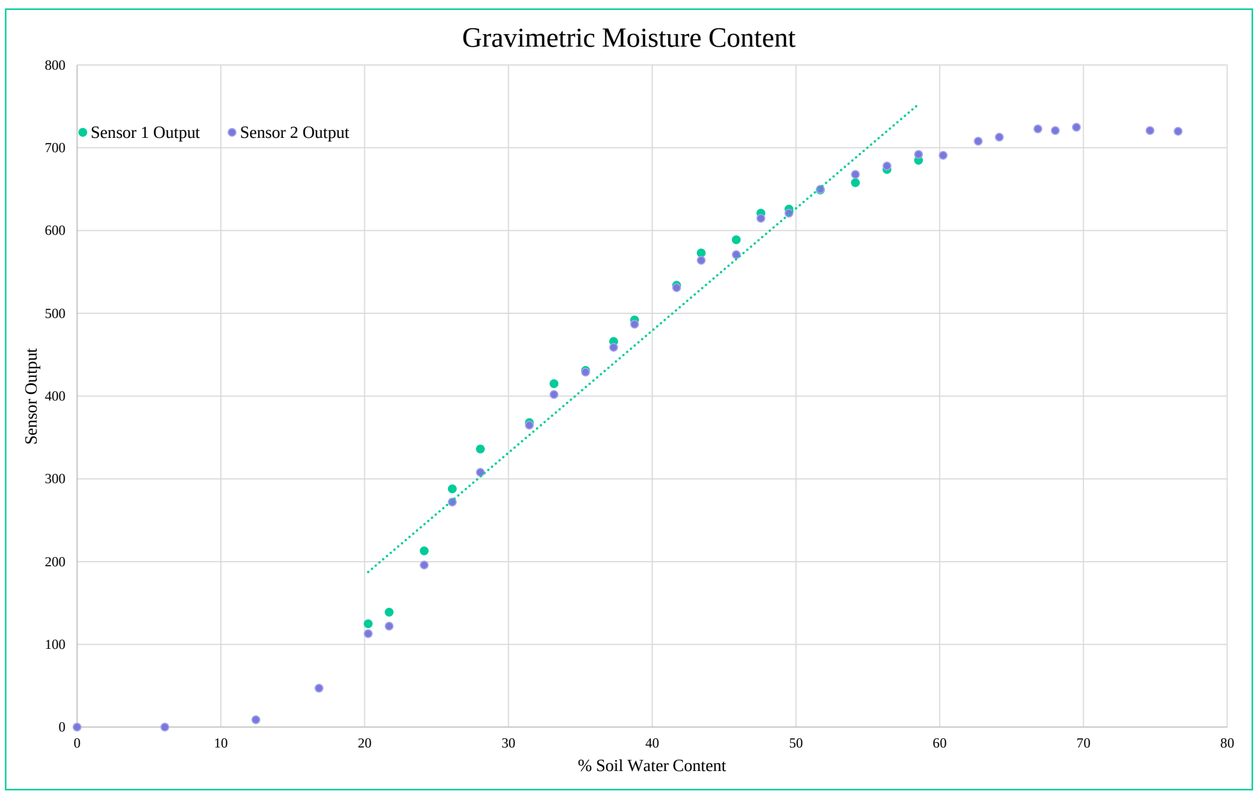
This program collects inputs from an LDR and two soil moisture sensors. A setpoint for the light dependent resistor prevents watering if the light levels are too low. Once it is daylight, the program will begin taking readings from the soil moisture sensors. The average of these values will be taken as the average soil moisture level. Once this value drops below a set level, a signal will be sent to open the solenoid valve. With the valve opened, a volume of water will be delivered to the soil by a drip irrigation system. The valve then shuts and a measure of soil moisture is taken again. This process is repeated until a satisfactory soil moisture level is reached.



Results & Conclusions

Testing

- To find a suitable LDR setpoint, varying light levels were applied as well as measurements taken at different points throughout the day.
- Soil moisture sensors were both calibrated to gather information on their output per ml of water added. This information was used to create a plot showing percentage soil moisture content. This is a more useful way of measuring soil moisture as it can be applied to any setup.
- The valve was found to release ≈300ml of water in a 10 second interval. This could be used in further work to estimate the amount of water delivered per day.



Future Work

- There is plenty of scope for future developments of a project like this. Extra probes can be easily added, such as an ultrasonic sensor to monitor level in the water butt, carbon dioxide sensors, or a soil NPK sensor.
- Extra outputs could be controlled such as artificial lighting and heating systems. The program could be altered to log the amount of time the valve is open each day, to estimate the daily water usage.
- With the use of a Wi-Fi enabled Arduino, the system could be set up to send an email or a tweet a couple of times a day. This could include information about the system or simply alert the user that the system is still active.

References

- Arduino Logo: https://www.arduino.cc/en/trademark
- Seeed Studios Logo: https://www.seeedstudio.com/
- Adafruit Logo: https://io.adafruit.com/