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CS 3651 A

Project Documentation: Smart Plant Waterer

Hardware Components:

- Capacitive Moisture Sensor
  - Used as the main method of detecting how moist the plant is

- 12V DC Peristaltic Pump
  - Used to pump the water from the bottle to the plant

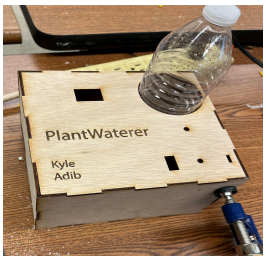
- Arduino Mega 2560 (from kit)
  - Used to control all sensors and actuate components
- 5V relay block (from kit)
  - Used to control the pump (turn on/off according to a digital pin write)
- DHT11 Temperature and Humidity Module (from kit)
  - Used to get temperature and Humidity information
- OLED Display Module SSD 1331 96*64 Resolution
  - Used to display information on a screen for the user to see

- 9V AC to DC Adapter (from the lab)
  - Used to power the pump
- 5mm diameter silicone tubing
  - Used to connect to pump and facilitate the water pumping and watering

Libraries Used:

- Adafruit_GFX: This library is used to provide various graphical functions like texts, drawing shapes etc. on OLED screens.
- Adafruit_SSD1331: This library is used to work with our OLED display module SSD1331.
- SPI: This synchronous serial communication interface is used to transfer data between microcontroller and peripheral devices such as displays, sensors etc.
- dht: This library is used for DHT series temperature and humidity sensors.

Designed Parts:



- Laser Cut Box to hold everything
  - Finger slotted box overall was generated in makercase
  - Modified for our purposes to include the right size and positioning of holes (such as the one for the bottle, the OLED display, the DHT11 sensor, and various holes for tubing, cables, arduino access
  - Also Included vector graphics for the device name and our names as well to decorate it

- 3D printed sensor cover
    - Made in TinkerCAD, took measurements from the sensor and created a perfectly snug-fitting case for it that would protect it from water/soil and also make it sit on top of soil at the right depth when pressed against soil with probe going in the soil

- 3D printed funnel
    - Made in TinkerCAD, took measurements of the bottle opening and made a well sized funnel to make refilling the bottle much easier, created the funnel by combining and subtracting various cones and cylinders from each other

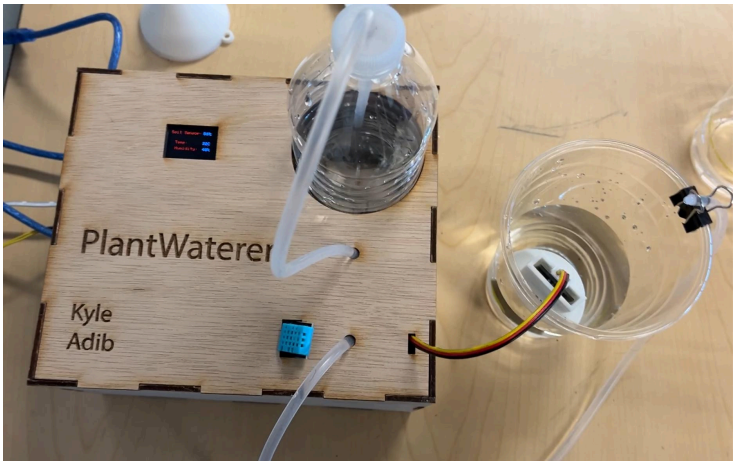
Skills Learnt:

- Learned how to display sensor values and draw shapes on an OLED screen with colorful texts and custom microcontroller pins..
- Learned how to wire up a relay block to control other devices via an input signal, something that can be applied to countless other projects
- Learned how to use various components like the Capacitive Soil Moisture sensor, and the DHT11 module
- Learned more about designing, prototyping, and creating real-world devices (using calipers to make measurements, making plans in illustrator/tinkerCAD)

Iterative Process:

- Our process was to first to finalize our idea of what we wanted to make: A automatic plant waterer in the most basic level
- We wanted to make sure that part, if nothing else, worked well and was presentable. We also had a few stretch goals that we either ran out of time for, or encountered too many obstacles while trying to implement
- We came up with a list of components we would need, and acquired them. We also looked up documentation and youtube videos on how to use each of these parts individually
- We tested each part individually first, to make sure we knew how to use them and they were working
- We then put everything together first on a breadboard to make sure it worked, then put everything together in a laser cut box while cutting down on size
- Some ideas that didn't pan out was our original stretch goal to make everything battery powered. Our device currently has 2 cables to be plugged in, 1 for arduino and 1 for the pump. While trying to power everything off of just one adapter, a single adapter was plugged into a breadboard's power rails and both the arduino and pump were connected to those rails as well
    - Unfortunately, the arduino used instantly stopped working, and probably burnt out. We decided to just keep everything as is to avoid further issues
- We also wanted to add an "alarm clock" functionality that let you set what intervals of time you wanted to water the plant instead of basing everything off the moisture sensor, but realized that a RTC module would be needed, and we didn't have time to get one at that point

Photo:



What was done in addition to tutorials found:

- Although there were tutorials explaining how to use each part individually, our project sought to combine all these parts into one cohesive device
- There were plant watering tutorials using the sensor and a cheap submersive pump online, but they were very simple (consisted of just sensor, arduino, pump, breadboard)
- We wanted to use a more controllable pump (peristaltic), and also add other functionality like readings of temperature and humidity, as well as a display to show all the data in a pleasing manner
- We also created a unique enclosure, with a water bottle as our water storage just so it's very easy for a user of this device to replace the water tank if anything happens with it
- Most of the tutorials related to OLED screens with arduino are based on arduino UNO where we were using arduino Mega 2560. The libraries we have been using for the OLED screen didn't work because the suggested pins were filling the screen with continuous colorful horizontal and vertical lines. In short, there was no response from the microcontroller. Initially we thought that the issue lies on our OLED screen that made us buy another screen resulting in the same problem. After that, we have carefully debugged the libraries and used our custom pin with customized function to make our OLED screen work.

Work Distribution:

- Kyle:
    - Brainstorming of Idea, sourcing parts, assembling a prototype as proof of concept
    - Worked a lot with the physical components: designing 3D printed parts, Laser cut parts, putting everything together.
    - Also worked with testing components functionality and adding them to the project iteratively: Moisture sensor, Peristaltic Pump, Relay Block
- Adib:
    - Brainstorming of Idea, planning out prototypes and final assembly
    - Worked a little with designing 3D printed parts and Laser Cut parts
    - Mainly worked on getting the display to work properly, debugging the problems with that
    - Also worked with testing components functionality and adding them to the project: OLED display, DHT11 Module