CPE 301, Embedded System Design
Final Project

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Final Project: CPE 301 Embedded System Design

Overview:

This overall project was tailored to all the previous work we have done throughout the entirety of Embedded Systems Design, by us designing and creating a miniature swamp cooler.. With the creation of the swamp cooler, we demonstrated our ability and growth of each of the previous 9 labs provided throughout the semester itself. Beginning the project, it seemed to be best to go about the physical and programming part of the lab together. It was decided that the best way to go about this project would be to build a singular part of the board, program that physical part/component to our liking, and repeat the process until the entirety of the project was finished.

Equipment Used:

Water Level Detection Sensor Module	LCD Strip
Breadboard x3	Potentiometer x2
Water/Humidity Sensor	USB Cable
Stepper Motor	Fan Blade and Motor
Stepper Motor Driver Module	Arduino Unit
Button	Real-Time Clock
LED x4	

Table 1 - List of required equipment for these experiments.

Construction:

1. **First Steps of the Project**

    a. We first began the project by going one section at a time. Beginning with the water level detection sensor module, we first began by adding the module to detect the water within a system. Putting this together was rather straightforward, as it was a simple connection on the physical board and with the use of the ‘LiquidCrystal.h’ library we were able to get it working in no time. This was also designed to give an answer in the serial monitor if the water reaches a below welcomed amount that read “Water is too low”. This undesired temperature is listed as 86+ degrees in Fahrenheit, translating to 30 degrees Celsius.

b. The second part began with us using the DHT11 temperature and humidity module. We then threw things on the breadboard and connected the LCD to the breadboard as well. Using one of the previous labs code LCD code mixed with some new, we were able to set up both of these in a timely manner. The LCD was then able to print the temperature and humidity in different integrals of time. This was then changed later throughout the lab which will be demonstrated later. This also displayed both the humidity and the temperature of the air in the serial monitor with a small delay. We later came to realize that when multiple components are connected to the breadboard it consumes a lot more voltage, this in turn makes the LCD suffer as its screen will dim to a point where it will start to glitch out. Having loose wires could have also led to this issue, as even with more power given to the circuit board and Arduino itself, the LCD seemed to still struggle. We had this fixed by attaching another power supply to the Arduino itself. Concluding the beginning steps of the project, the design can be shown below listed as Figure 1.

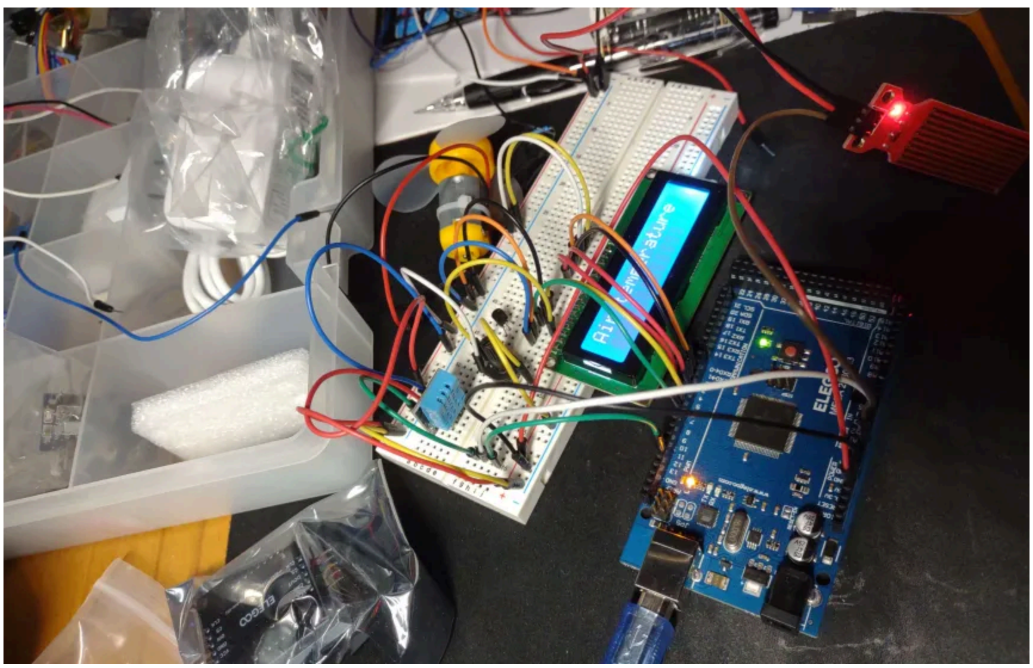

Fig. 1 - Stage 1 of Swamp Cooler Design

2. Continuing Steps of the Project

c. The third step of the project began with us implementing the fan and motor onto the breadboard. We started to overcomplicate the design, as we originally used a transistor to help break up and power the motor, which later realized this was completely unnecessary. We then simplified this by just connecting the black wire into the ground, while then connecting the red wire into one of the analog slots. Using loops in Arduino we adjusted the fan to start and stop depending on whether the temperature went out of the range of the desired temperature values.

d. The fourth part of the lab began with the implementation of the output vent for the system. To replicate this, we simply used a stepper motor with a potentiometer. This potentiometer controlled whether the “vent” being the stepper motor, would either turn one way or another, simulating opening and closing a vent. Since the motor itself became very slow, we then realized that the Arduino itself does not have enough power. Using the provided 9V1A adapter, we plugged this into the Arduino itself to give it enough power to run all the components of the system. The continued unfinished part is shown below as Figure 2.

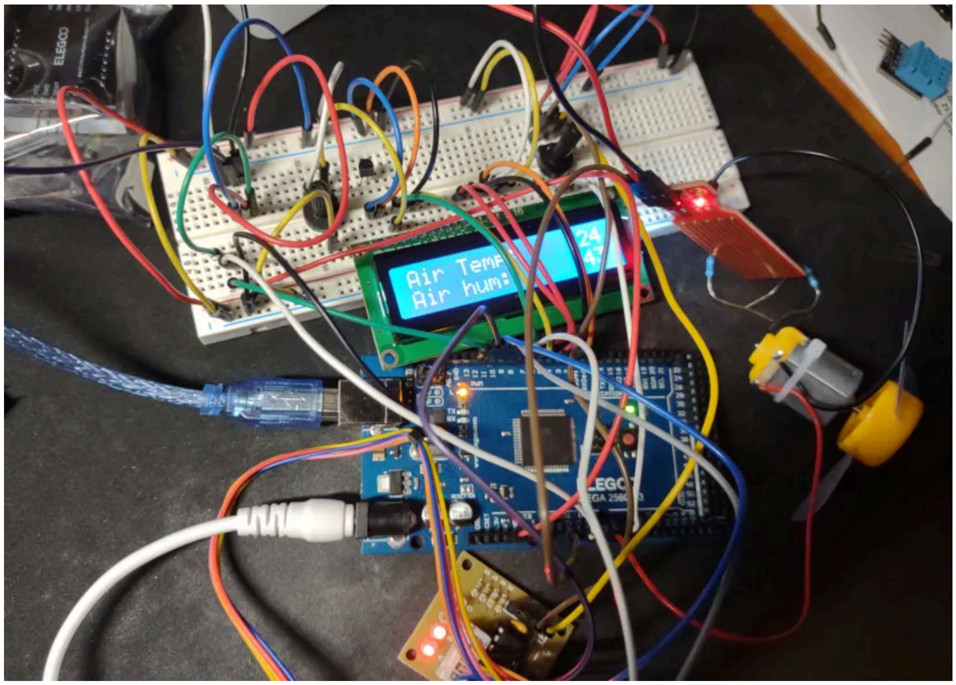

Fig. 2 - Stage 2 of Swamp Cooler Design

3. Nearing the finish of the Project

e. The fifth step of the project was for us to implement an on/off button to completely enable/disable the system. For this we used the attachInterrupt function. This took quite a while to design and program, as we kept having to use different ports to figure out exactly what works with the interrupt and what does. Eventually we settled on ports 18 and 19 in the “communication” section of the arduino board. For this we implemented two different buttons which one enables the system, while the second disables the system. This is used as a shut-off and shut-on “switch” for the swamp cooler itself.

f. The sixth part of this lab started with us adding the DS1307 RTC module to the SDA and SCL ports on our arduino board. With this we are able to keep track of time and date every time the motor is either on or off. This was directly used for reporting events in the system. With everything coming to a close, our near finished design is shown below listed as Figure 3.

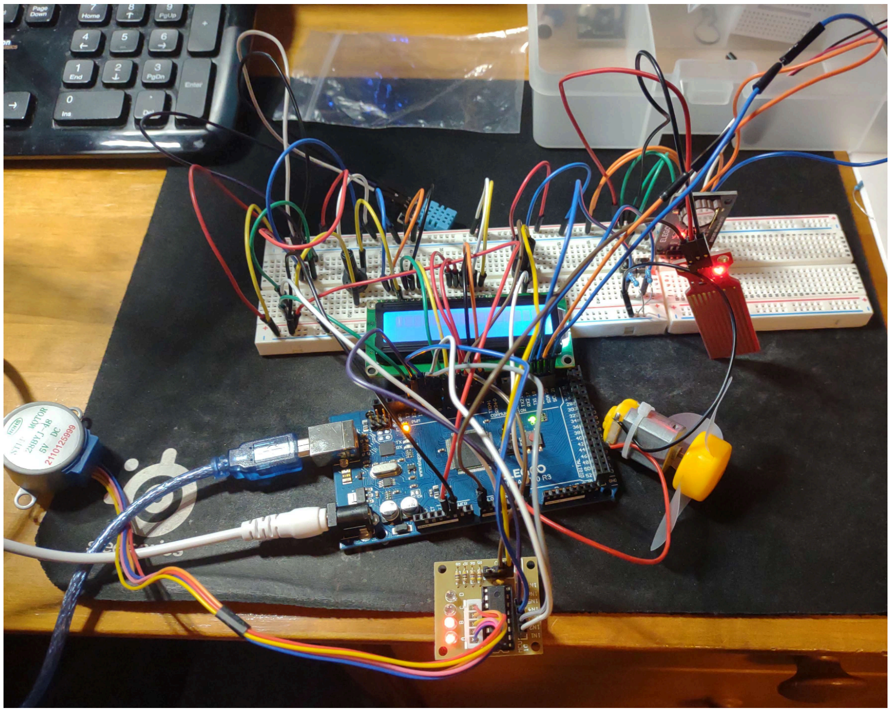

Fig. 3 - Stage 3 of Swamp Cooler Design

4. The final components and design

g. The final part of the cooler starts off with us implementing a series of LED’s to describe the state of the system. This included adding four different LED’s to the design to describe the state of the system. Yellow represents the “disabled” state of the system, green represents the “idle” state of the system, red represents the “error” state, while lastly the blue represents the “running” state of the swamp cooler. All of these are determined by different factors provided in the project manual itself. Programming this proved to be quite a bit more difficult than expected, as we had to rearrange the entirety of our code. This was done by creating the four states listed earlier, then putting our previous code into each of the specified states. Doing this led us to our final design, this is shown listed as Figure 4.

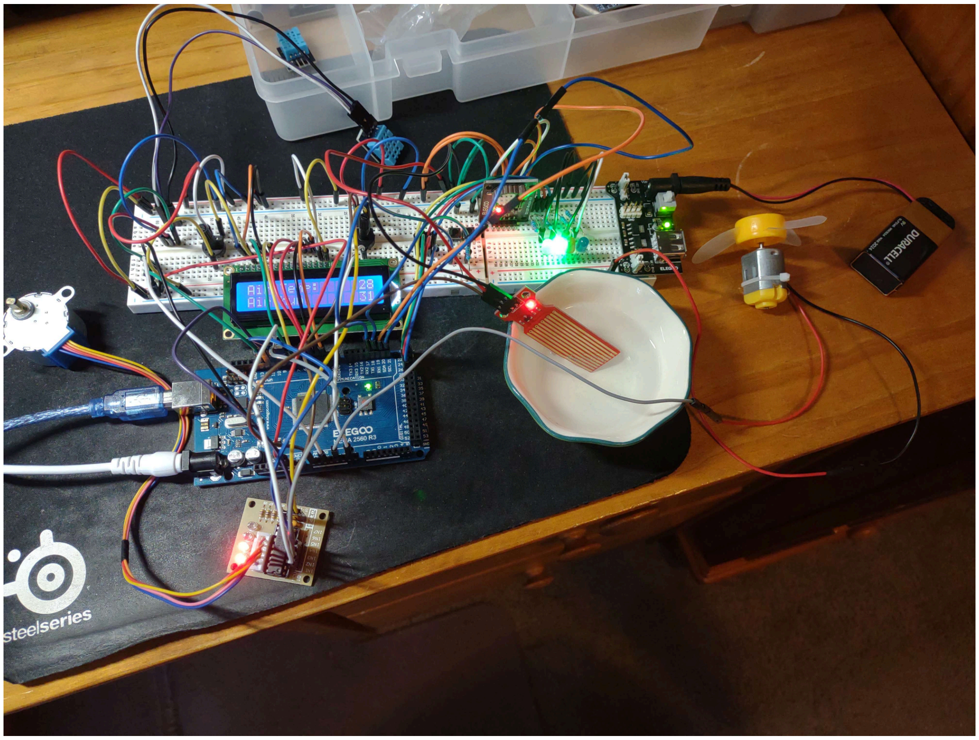

Fig. 4 - Final Design of Swamp Cooler System

Demonstration Video & Github link:

https://www.youtube.com/watch?v=irfOvBpTRDo

https://github.com/EthanTKalb/CPE301_FinalProject