Swamp Cooler Technical Document

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Abstract:

This project aims to design and implement a swamp cooler using concepts learned in previous labs. The cooler works by drawing air through a wet pad, initiating an evaporation process that cools and humidifies the air. The project incorporates various elements from the course, including GPIO, ADC, Timers, and UART, to build a functioning system.

Introduction:

For this lab, the goal was to build a swamp cooler using an Arduino and a breadboard, ensuring that no restricted library functions such as PinMode, DigitalRead, DigitalWrite, Delay, AnalogRead, and Serial() were used. The circuit operates through four states: Disabled, Idle, Running, and Error, each corresponding to specific behaviors. Initially, when connected to the monitor, the board enters the Disabled state, displaying a message that says "system is ready." The yellow LED and stepper motor operate during this state, and remain on until the start button is pressed. Upon pressing the start button, the state transitions to Idle, where the green LED lights up, and the LCD displays the current temperature and humidity. The stepper motor continues its motion, and the green LED indicates that the water level is sufficient. If the water level drops below a threshold, the system enters the Error state, where the red LED turns on, the LCD displays a warning message, and the motor stops. Pressing the restart button returns the system to Idle, while the stop button brings it back to Disabled. In the Running state, the fan motor turns on, and the LCD continues to display the temperature and humidity. The blue LED indicates this state, and if the water level falls below the threshold or the temperature drops below

the threshold, the system will transition to Error or Idle respectively. The system continuously cycles between these states based on user interactions and sensor readings.

Experimental Design:

To recreate a swamp cooler, the following components are used:

- **Arduino Mega 2560: This board serves as the main controller, wiring the system components together and providing power. It is programmed using the Arduino IDE to monitor and control temperature, humidity, and water levels.**
- **LEDs: Four LEDs represent the system's state: Yellow (Disabled), Green (Idle), Blue (Running), and Red (Error). Each state is determined by the status of temperature, humidity, and water level sensors.**
- **Buttons: The push buttons allow user interaction to switch between states. The stop button always transitions the system to Disabled, the start button moves the system from Disabled to Idle, and the reset button changes the system from Error to Idle when the water level is above the threshold.**
- **DHT11 Temperature and Humidity Sensor: This sensor measures the system's temperature and humidity. It helps determine whether the system should transition to Running or Idle based on predefined thresholds.**
- **DS1307 RTC Module: This real-time clock module tracks the time and date, recording when the system starts, ends, and changes states.**
- **Rotary Potentiometers: One potentiometer adjusts the LCD’s brightness, while the other controls the direction of the stepper motor.**

- **LCD 16x2 Module: This module displays critical system information, including the date, time, temperature, and humidity. The data is updated every minute using the RTC and sensor modules.**
- **Water Detection Sensor: This sensor monitors the water level, ensuring it remains above the threshold. If the water level drops below the threshold, the system enters the Error state.**
- **Stepper Motor and ULN2003 Driver: The stepper motor is used to simulate the motion of the cooler's fan. The motor's direction is controlled by a potentiometer, and it operates at a speed of 200 steps per minute. The motor's movement is powered by a 9V battery.**
- **Fan and Motor: A 3-6V motor powers the fan, which is activated when the temperature exceeds the threshold. The fan operates at 90 revolutions per minute to cool the system.**
- **Resistors: 330Ω pull-up resistors are used with the buttons to prevent overloading the Arduino, while 1KΩ pull-down resistors are used for the colored LEDs.**
- **Cirkit Designer: This software is used to visualize the project's schematic and generate a component list with prices, helping to design and plan the system on a 2D plane.**

Components and software:

Components	Pin Number
Arduino Atmega 2560	
Laptop or Lab PC with Arduino IDE installed	
4x LED two pin (Yellow, Blue, Green, Red)	Yellow- Green-24 Blue-26 Red-28
3x Push buttons (Start,Stop, Reset)	Start-2 Stop-32 Reset-34
2x Rotary Potentiometer(LCD, Stepper Motor)	Stepper Motor- LCD-
LCD 1602 Module 16 pin	22.23,24,25,26,27
5x 1kΩ	
Water Level Detection Sensor Module	a0
Fan Blade and 3-6V Motor	

Stepper Motor	
ULN2003 Stepper Motor Driver Module	29,31,30,32
DHT11 Temperature and Humidity Module	7
DS 1307 RTC Module	20 SDA, 21 SCL
9V battery with Snap-on connector clip	
Cirkit Designer	
Power Supply Module (20% Threshold)	
BreadBoard Jumper Wires	
Hair pin/ Tape	
L293D IC	5,4,3

Components Spec Sheets:

DHT11 spec sheet - https://www.circuitbasics.com/wp-content/uploads/2015/11/DHT11-Datasheet.pdf

Water sensor sheet - https://arduinogetstarted.com/tutorials/arduino-water-sensor

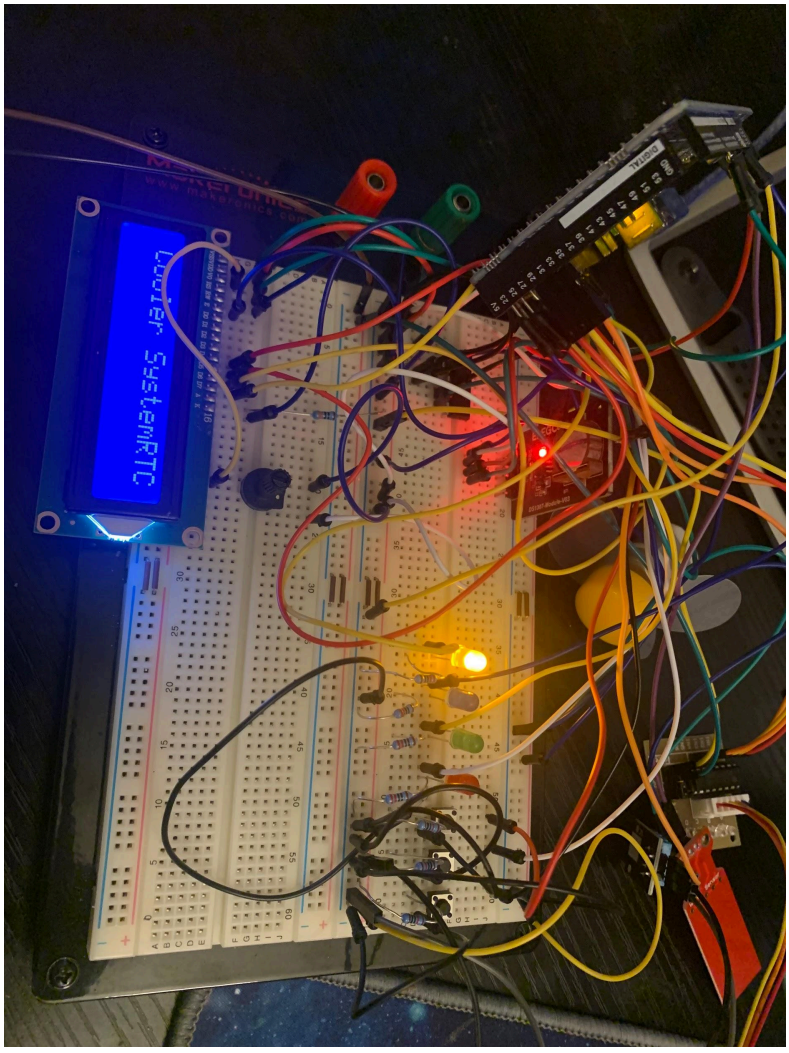
Github Repository - https://github.com/ChrisR324/CPE-301-Final-Project.git

Schematic -https://projects.cirkitdesigner.com/view-maker-hub-project/26814
Schematic Documentation-
https://docs.google.com/document/d/1NkYQHv57jV5PzFmgce0OCeGKbxA5EP1ZrxBx4MHa7OE/edit?usp=drivesdk

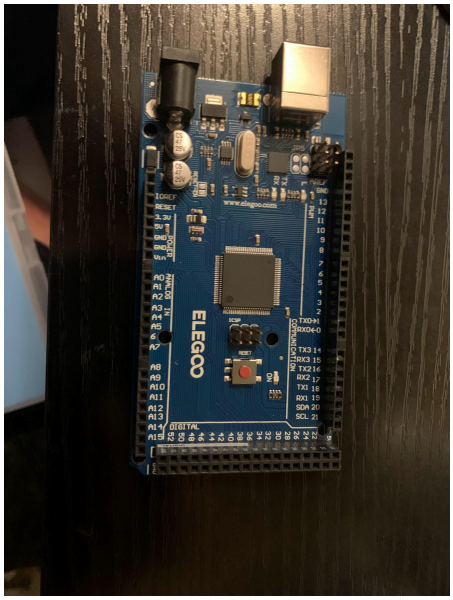
Project Results:

Pictures

Overall Project



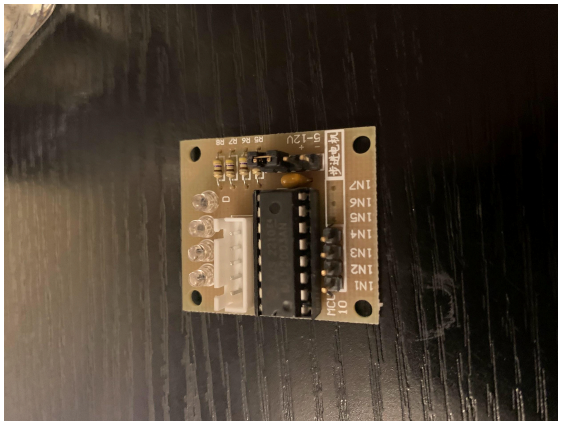
Arduino Atmega 2560


ELEGOO

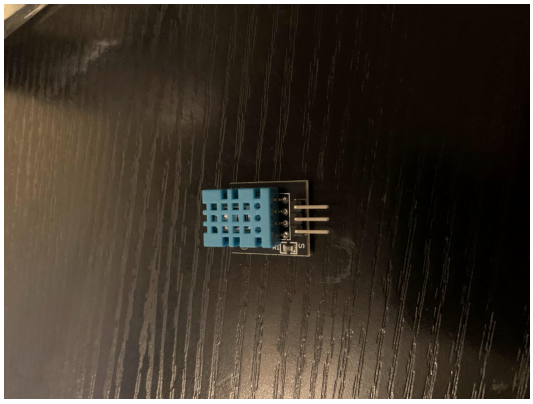
9V battery

Stepper Motor

UNL2003 Stepper Motor Driver Module

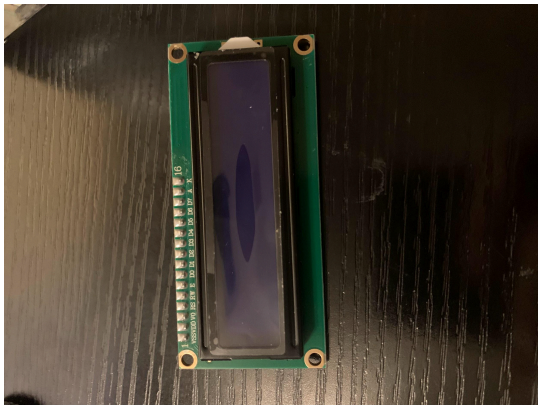


DHT11 Temperature and Humidity Module



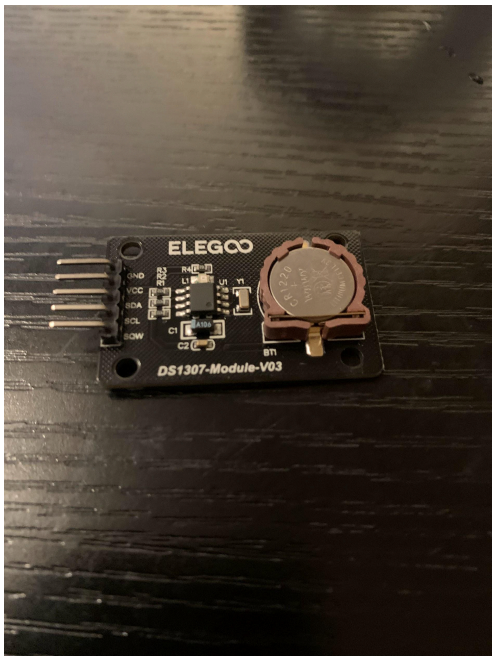
Fan Blade and 3-6V motor

LCD 1602 Module 16pin

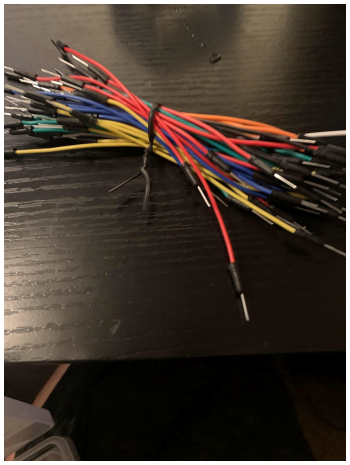


Water Level Detection Sensor Module

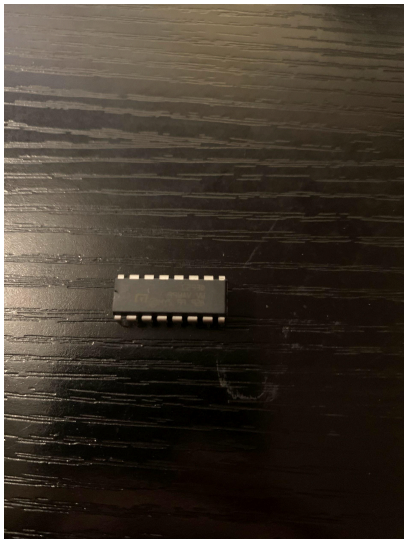
DS 1307 RTC Module



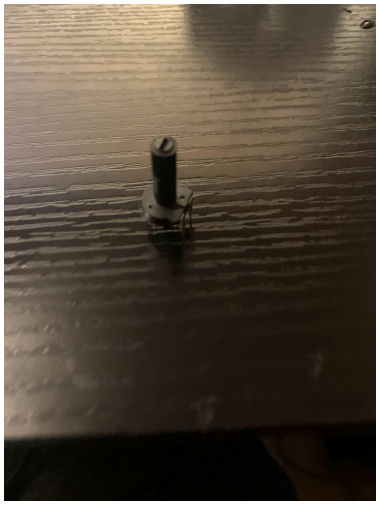
Bread Board Jumper Wires (Male to Male)



L293D IC unit



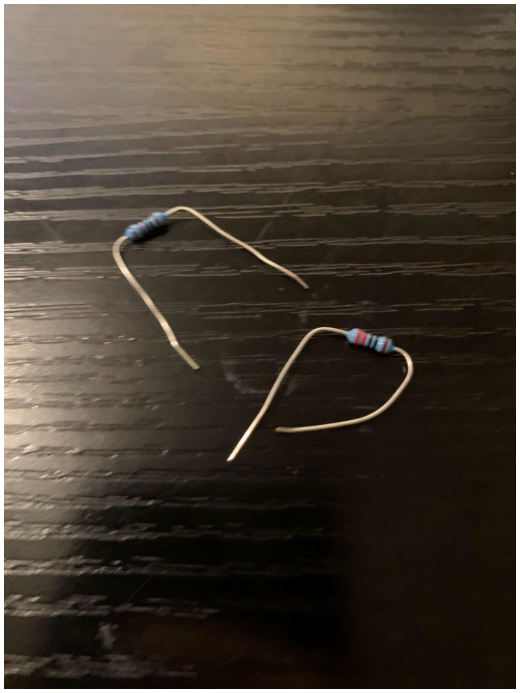
Rotary Potentiometer



Push Buttons

LED

Resistors (1KΩ and 330Ω)



Power Supply Module