Project Overview

Overview of the Design

This project implements a swamp cooler control system using an Arduino Mega 2560, with additional support from an Arduino Uno. The system is designed to monitor environmental conditions and control cooling operations based on predefined thresholds. Key components include a temperature and humidity sensor (DHT11), an LCD for data display, LEDs for state indicators, a fan motor with an L293D driver, a stepper motor with a ULN2003 driver, and control buttons.

Design Modifications

1. **Water Sensor Simulation**:
   A button was used to simulate water level detection in place of a missing water sensor. Pressing the button indicates a low water level, allowing the system to transition to the error mode.

2. **Time Module Replacement**:
   Instead of a Real-Time Clock (RTC) module, the `millis()` function was used to track elapsed time for periodic updates on the LCD.

3. **Stepper Motor Power Supply**:
   The stepper motor and ULN2003 driver were powered using an **Arduino Uno**, which supplied the necessary 5V while operating independently of the Arduino Mega.

4. **Power Module Usage**:
   A power module from the starter kit was used to provide stable 5V and 3.3V power for the fan motor, ensuring reliable operation.

Design Details

- **No Restricted Library Functions**:
  The design strictly avoided using restricted Arduino library functions , except for LiquidCrystal, attachInterrupt, and DHT. Direct register manipulations were used for pin configuration, reading, and writing to achieve low-level hardware control.

- **State Management**:
  The system operates in four states:

  - **Disabled**: System off, yellow LED on.
  - **Idle**: Waiting for conditions, green LED on.

    - **Error**: Low water level detected, red LED on.
    - **Running**: Cooling actively, blue LED on.
- **Key Functionalities**:

    - Environmental data (temperature and humidity) is displayed on the LCD every minute using the millis() function.
    - Buttons are used to control transitions between states and to simulate sensor inputs.
    - The fan motor is controlled via an L293D motor driver.
    - The stepper motor, controlled via the ULN2003 driver, is powered by the Arduino Uno for independent operation.

System Constraints

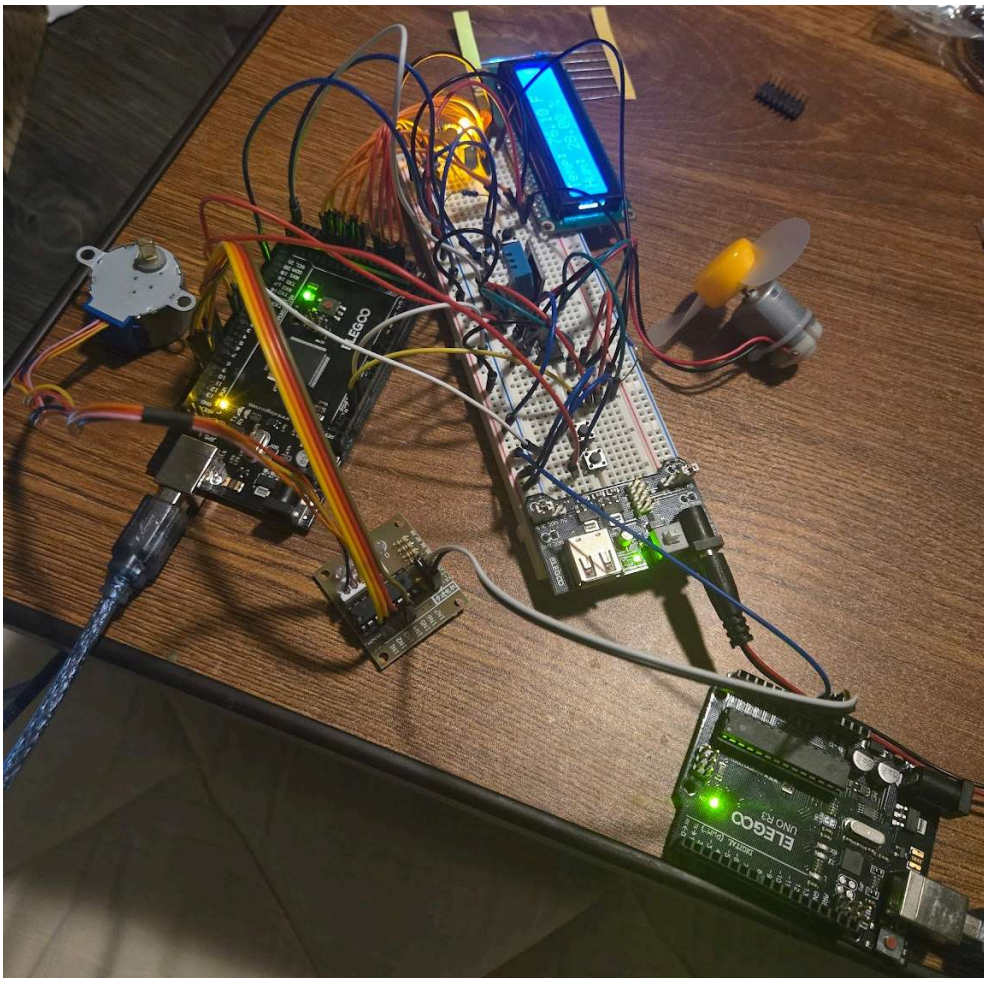
1. **Operating Temperature**:

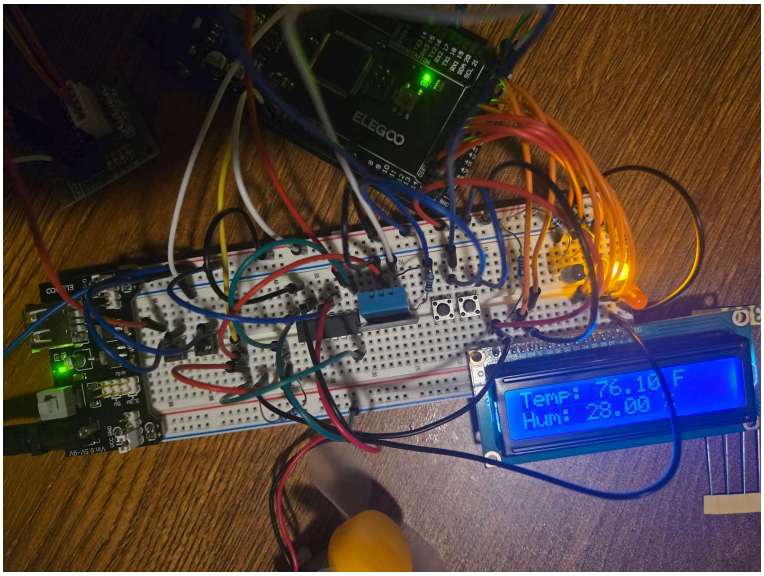
    - The DHT11 sensor supports temperatures between **0°C to 50°C** (32°F to 122°F). The system is designed to operate optimally within this range.
2. **Power Requirements**:

    - **Arduino Mega 2560**: Powered via USB (5V) or an external power supply (7-12V recommended).
    - **Arduino Uno**: Powered via USB or an external 5V source, supplying power to the ULN2003 and stepper motor.
    - **Fan Motor**: Requires 3-6V, powered via the power module and controlled through the L293D motor driver.
    - **Stepper Motor**: Operates on 5V, supplied by the Arduino Uno.
3. **Environmental Conditions**:

    - The LCD and DHT11 operate best in non-condensing environments with moderate humidity levels.
    - Indoor operation is recommended for stable conditions.

Pictures of the Final System





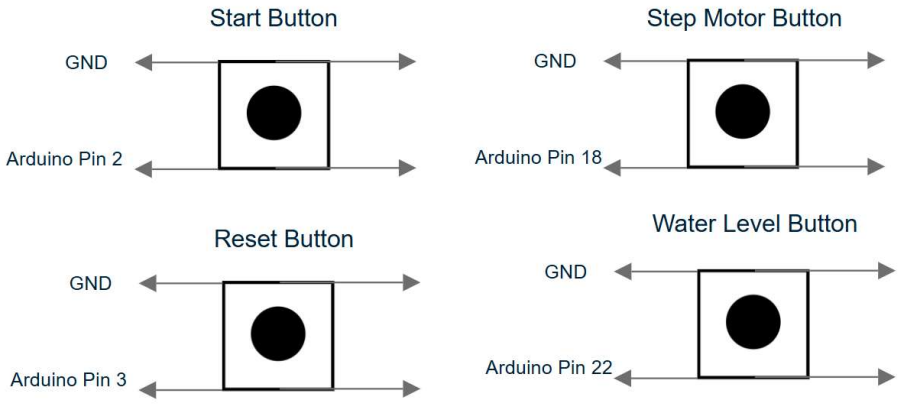
Video Demonstration

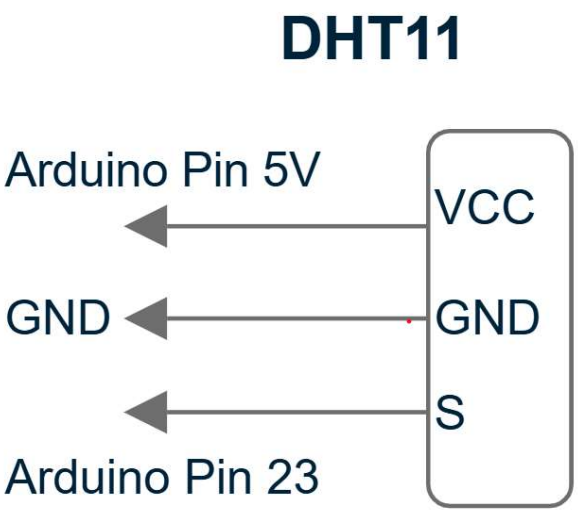
The video demonstrating the system in operation is available at the following link: https://youtu.be/bywO2HgUOBo?feature=shared

Complete Schematic

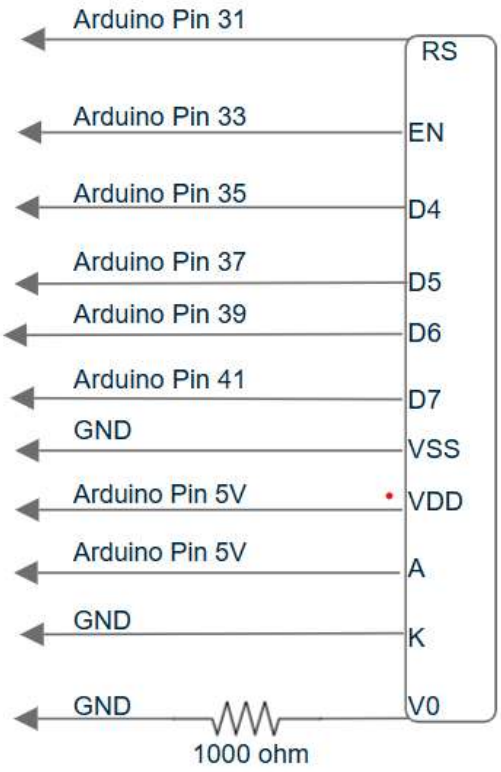
The schematic includes:

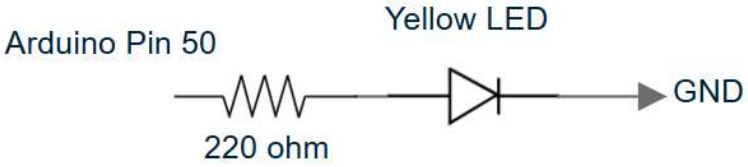
- Connections between the Arduino Mega, LCD, LEDs, DHT11 sensor, buttons, fan motor (via L293D), stepper motor (via ULN2003), and power module.

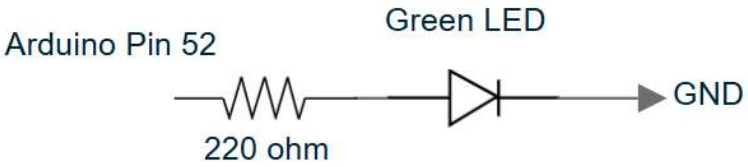


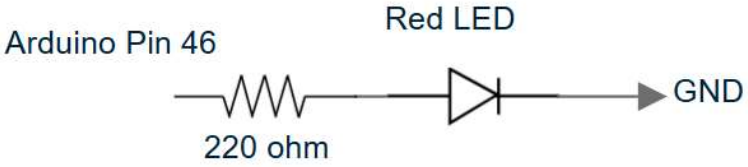


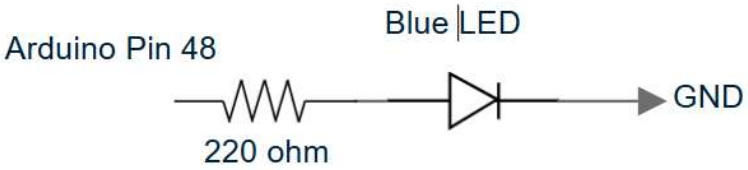
LCD1602

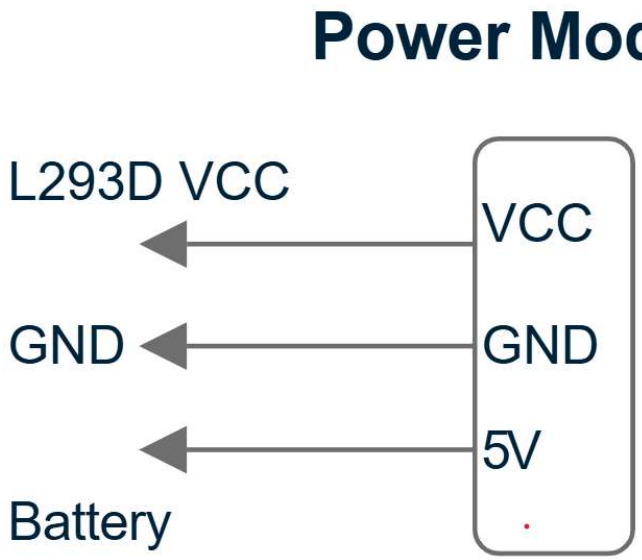

Arduino Pin 31
RS
Arduino Pin 33
EN
Arduino Pin 35
D4
Arduino Pin 37
D5
Arduino Pin 39
D6
Arduino Pin 41
D7
GND
VSS
Arduino Pin 5V
VDD
Arduino Pin 5V
A
GND
K
GND
V0
1000 ohm

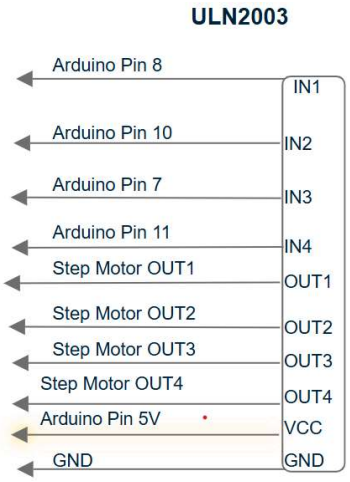

Yellow LED
Arduino Pin 50
GND
220 ohm


Green LED
Arduino Pin 52
GND
220 ohm


Red LED
Arduino Pin 46
GND
220 ohm


Blue LED
Arduino Pin 48
GND
220 ohm





Specification Sheets

Relevant datasheets for the components:

1. **Arduino Mega 2560**: Arduino Mega Datasheet
2. **Arduino Uno**: Arduino Uno Datasheet
3. **DHT11 Sensor**: DHT11 Datasheet
4. **LCD (16x2)**: 16x2 LCD Datasheet
5. **L293D Motor Driver**: L293D Datasheet
6. **ULN2003 Stepper Motor Driver**: ULN2003 Datasheet
7. **Fan Motor**: DC Motor Datasheet
8. **Power Module**: Power Module Datasheet

GitHub Repository

The complete source code and documentation are available here:
GitHub Repository