Group: Ajani Ezekiel Robards-Stokes
CPE 301.1001
Professor: Bashira Akter Anima
TA: Russell Keith
December 15, 2023

Overview of the Design and Constraints

Project Summary

The project aims to develop an evaporation cooling system, also known as a swamp cooler, using Arduino components and sensors. The system is designed to monitor water levels, display temperature and humidity, control a fan motor, adjust the vent angle, and record the time and date of motor operations. The implemented system follows specific state transitions and employs various components, such as a stepper motor, LCD display, real-time clock (RTC), temperature/humidity sensor (DHT11), water level sensor, fan motor, LEDs, buttons, and a potentiometer.

System Constraints and Design Considerations

Operating Temperatures

The system's operation is designed for environments where evaporation cooling is effective, typically in dry and hot climates. It relies on the principle of evaporative cooling and may not perform optimally in humid conditions.

Power Requirements

The system incorporates a variety of components, each with its own power requirements. It is essential to connect the fan motor to a separate power supply board to prevent potential

damage to the Arduino output circuitry. The power supply board is not directly connected to the Arduino.

Component Selection

Water Level Sensor

The water level monitoring utilizes a water level sensor from the Arduino kit. Threshold detection can be implemented using either an interrupt from the comparator or via sampling using the ADC. The ADC library is restricted for this purpose.

Stepper Motor

The vent direction control is implemented using a stepper motor. Control inputs can be provided through either buttons or a potentiometer. The Arduino libraries for the stepper motor are allowed for this implementation.

LCD Display

The LCD display is used for presenting system messages. The Arduino library for the LCD can be employed for this purpose.

Real-Time Clock (RTC) Module

The RTC module is utilized for recording the time and date of each state transition. The Arduino library for the clock is permitted for this function.

Temperature/Humidity Sensor (DHT11)

The DHT11 sensor is employed for obtaining temperature and humidity readings. The Arduino library for this sensor is allowed for reading data.

Fan Motor

The kit motor and fan blade are used for the fan motor. It is crucial to use the included separate power supply board to avoid damage to the Arduino output circuitry.

System States and State Transitions

The system operates through several states: DISABLED, IDLE, ERROR, and RUNNING. Each state has specific requirements, such as LED indications, monitoring activities, and response to user inputs.

State Diagram

The state diagram illustrates the transitions between different states based on user actions and system events. Transitions trigger specific actions, including the monitoring of humidity and temperature, vent position control updates, and LED indications.

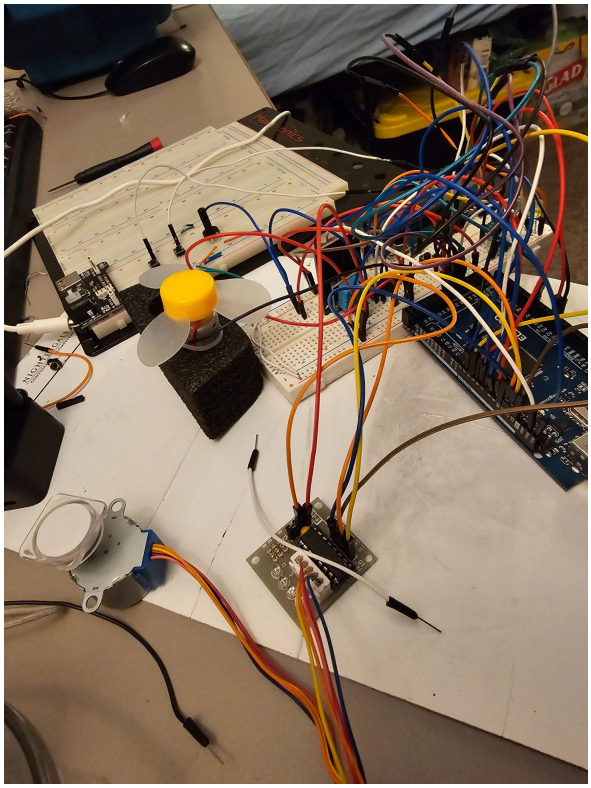
User Interface

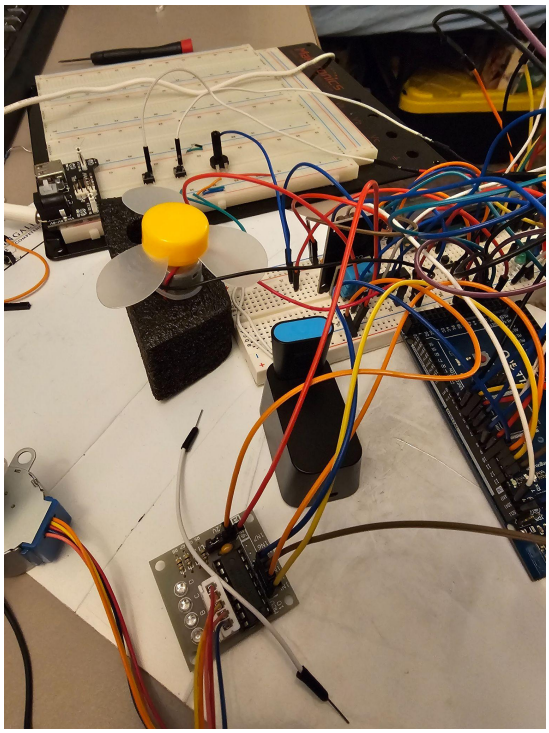
The user interface includes buttons for starting, stopping, and resetting the system, as well as a potentiometer for adjusting the vent direction. The LCD screen provides continuous updates on temperature and humidity, along with relevant system messages.

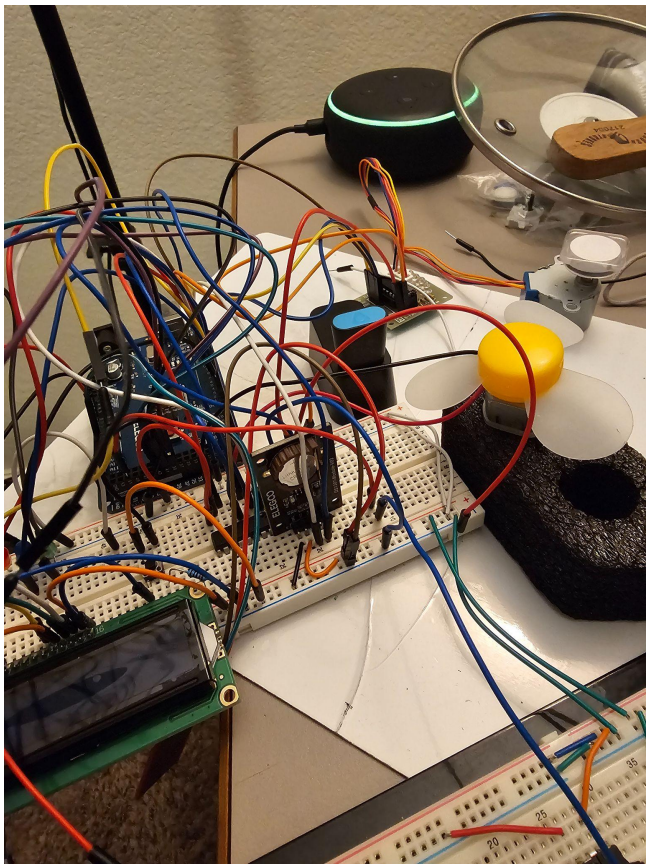
Conclusion

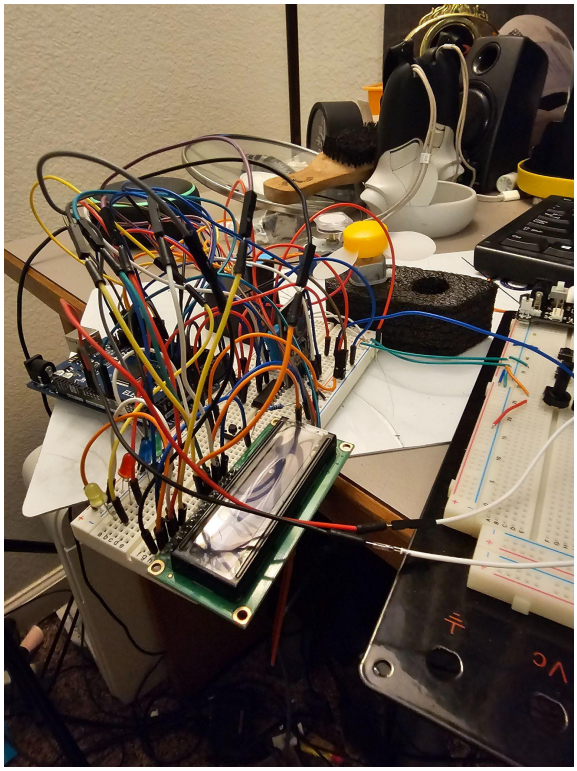
The design of the evaporation cooling system involves careful consideration of component selection, operating principles, and user interface. Constraints such as operating temperatures and power requirements influence the choice of components and their connections. The state diagram and state descriptions provide a comprehensive overview of the system's behavior in different scenarios. The user interface elements, including buttons, potentiometer, and LCD display, contribute to the system's functionality and user interaction. Overall, the system is designed to efficiently and intelligently control the evaporation cooling process based on environmental conditions.

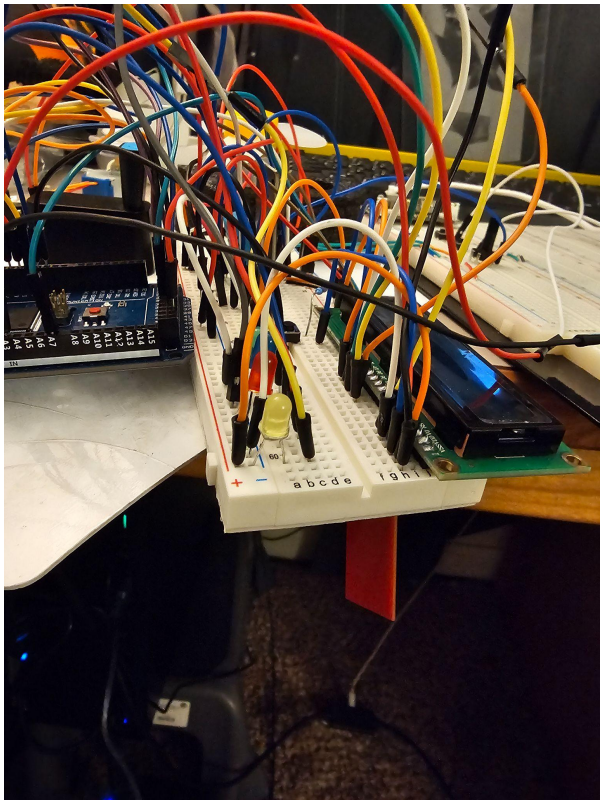
Pictures:

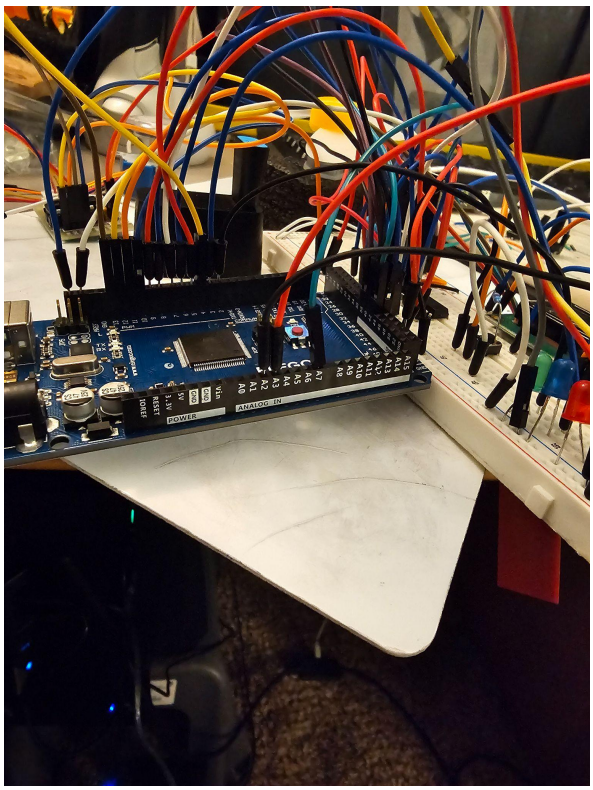


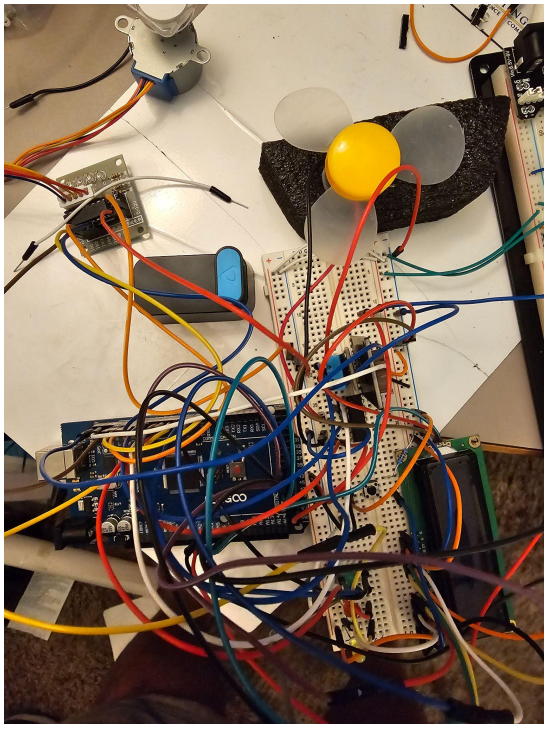


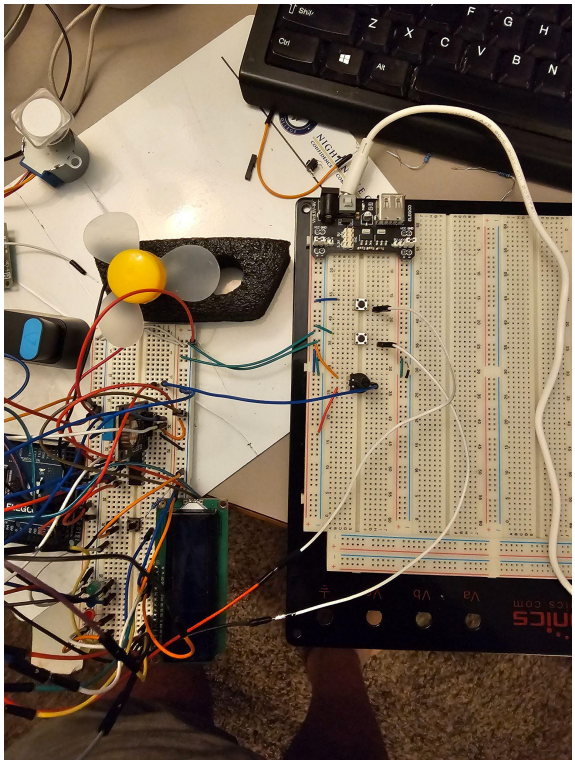


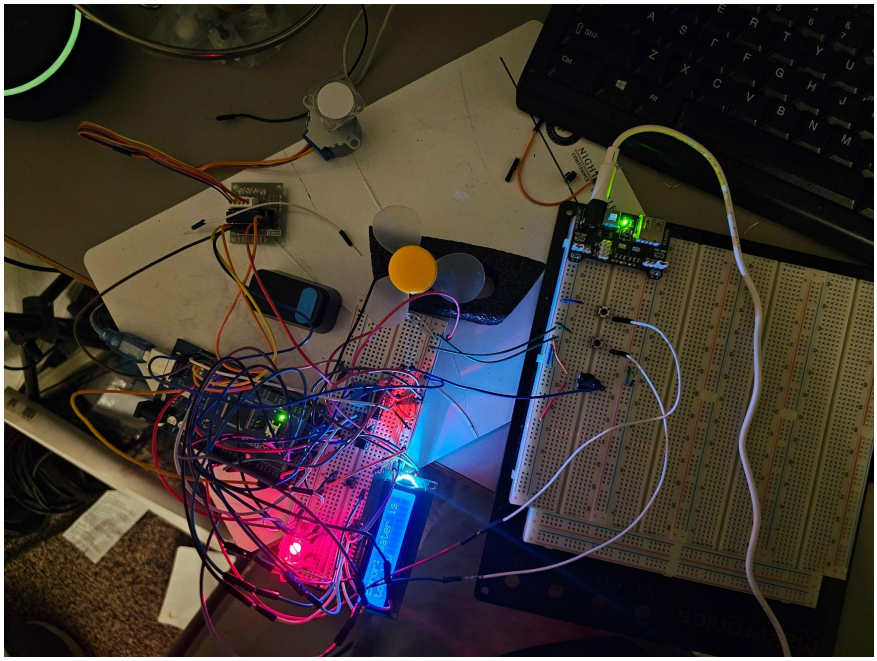




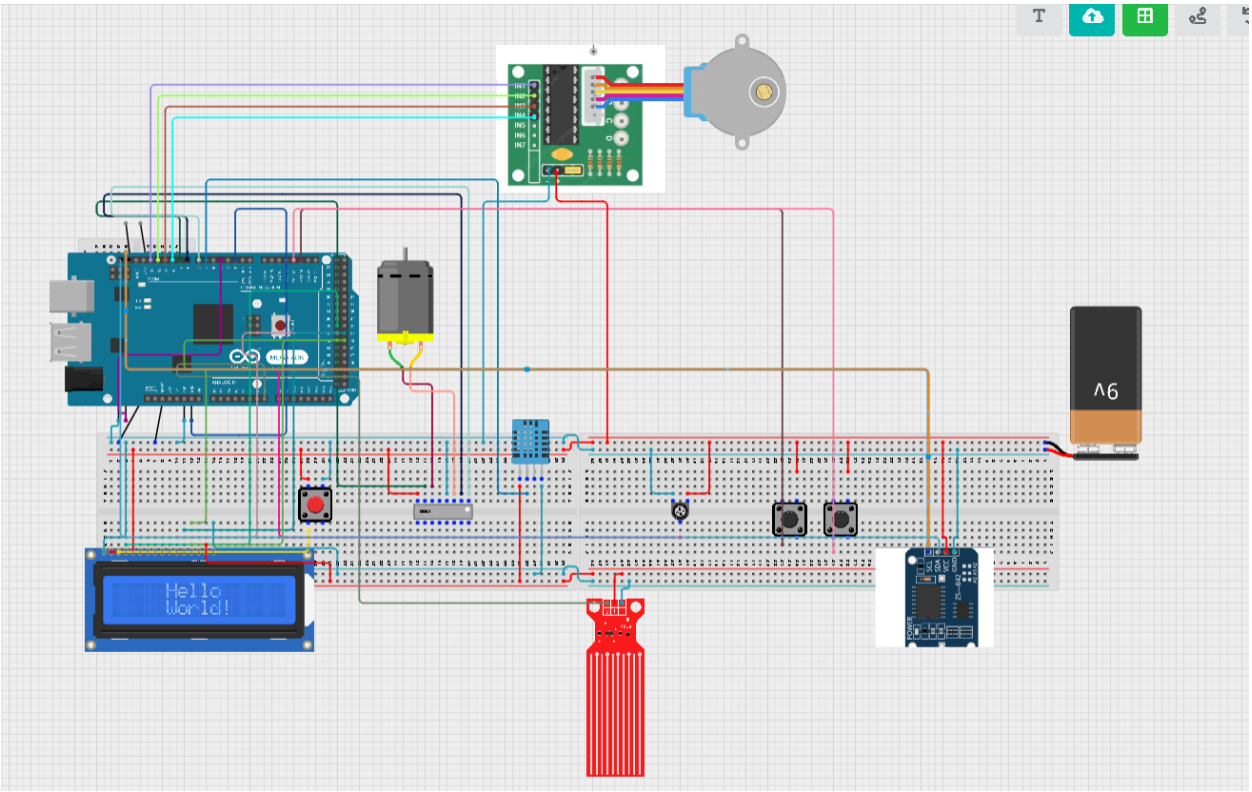








Schematic:



Github: https://github.com/1104-Robards-Stokes-AjaniEzekiel/CPE-301.1001-Final-Project

Specification Sheets:

Arduino:
https://ww1.microchip.com/downloads/en/devicedoc/atmel-2549-8-bit-avr-microcontroller-atmega640-1280-1281-2560-2561_datasheet.pdf

DHT11 Sensor:
https://components101.com/sensors/dht11-temperature-sensor

ULN2003 Motor Module:
https://www.electronicoscaldas.com/datasheet/ULN2003A-PCB.pdf

Real Time Clock:
https://www.sparkfun.com/datasheets/Components/DS1307.pdf

L293D datasheet:
https://www.ti.com/product/L293D

Operation video:
https://youtu.be/ZQaCJuoeqPE?si=N0IzgoYzUpHa9Iqt