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CPE 301: Section 1006

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Final Project Overview

Introduction:

This Overview will go over the Functionality, Components, and Design of a Theoretical Swamp Cooler. As well as Provide links to a GitHub Repository, a Video of the Functioning System, and all sources for utilized libraries.

GitHub Link: https://github.com/hharkleroad/CPE301FINAL

Video Link: https://youtu.be/zTrkehrT0jc

Design:

Circuit-

This Circuit is Divided in to two regions, 1 powered by the MEGA 2560 (MEGA), the other powered by the power supply module. The power supply provides power to the two motors, the stepper control knob, and both driver chips, to avoid the voltage from harming the MEGA. Every other component is powered by the MEGA. The two regions are connected via connection from the drivers, and knob to the MEGA.

The Second region provides power to the LCD, Water Sensor, RTC, and DHT11. All But the Water Sensor is connected to digital pins on the MEGA, which utilizes an analog pin to detect the water level. The RTC utilizes the SDA and SCL pins, and a push button utilizes 1 external interrupt pin. Everything else utilizes normal GPIO functionality.

Code-

The Code to this project is very extensive and can be seen by utilizing the GitHub link. For a basic overview, the beginning of the Code declares all global variables, libraries, and register pointers utilized throughout the code, as well as the ISR setup. The Setup set Baud rate and all components utilized. The loop runs through the various states of machine based off the global variables. The end of the code defines all functions utilized in the function and loop. The utilized libraries for the project include:

Stepper by Arduino: https://www.arduino.cc/reference/en/libraries/stepper/

LiquidCrystal by Arduino: https://docs.arduino.cc/learn/electronics/lcd-displays/

DHT11 by Dhruba Saha: https://github.com/dhrubasaha08/DHT11

DS3231 by Rinky-Dink Electronics: http://www.rinkydinkelectronics.com/library.php?id=73

Functionality:

The Cooler Runs Through 4 states: Power, Idle, Running, Error. The Time is recorded to the serial Monitor whenever there is a state change. The Power state is indicated by a yellow LED, and nothing is operational until the power button is pressed, which triggers a rising INT in the MEGA to move on to the Machine states. The Idle state turns on all the sensors, displays the temperature and humidity to the LCD every minute, and the step motor can be adjusted. The Running state is triggered when the temperature rises above 23C. This triggers the enable pin on the L293D to turn on the DC motor, and the step motor is still operational, as well as the updating LCD. When the temp returns to 23C or lower, the cooler returns to the Idle state. The Error state occurs when the water level is too Low which reads as 10 or lower on the water level sensor. An error message appears on the LCD and the motors are not operational. The system

can be powered on and off but remain in Error until the water level reads 27 or above and the reset button is pressed.

Some issues encountered were switch bouncing from the ISR. This can be minimized by pressing and holding the button until the state changes then releasing. The is also occasional noise causing the step motor to move without the knob being turned, a pull-down resistor helps reduce the occurrence of the issue but hasn't eliminated it. Due to limitations of the serial functions, the string var provided from the RTC library, the time sent to the serial monitor is not a readable character. The correct time is displayed with the Serial.print() Function however that function is out of the scope of this project.

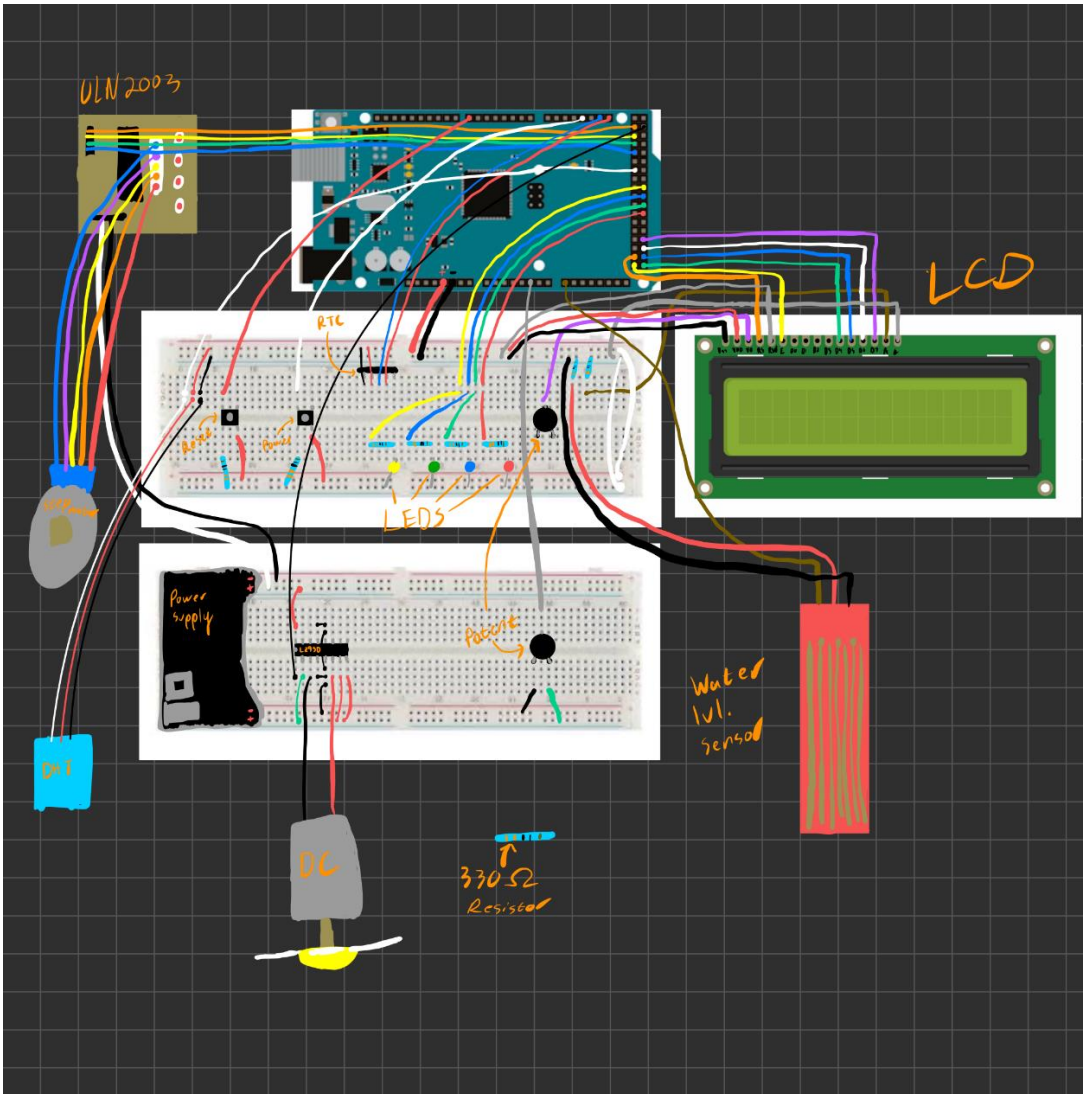
Components:

This project utilizes a variety of components from the Elegoo "Mega 2560 The Most Complete Starter Kit". (See Applicable Data Sheets Below)

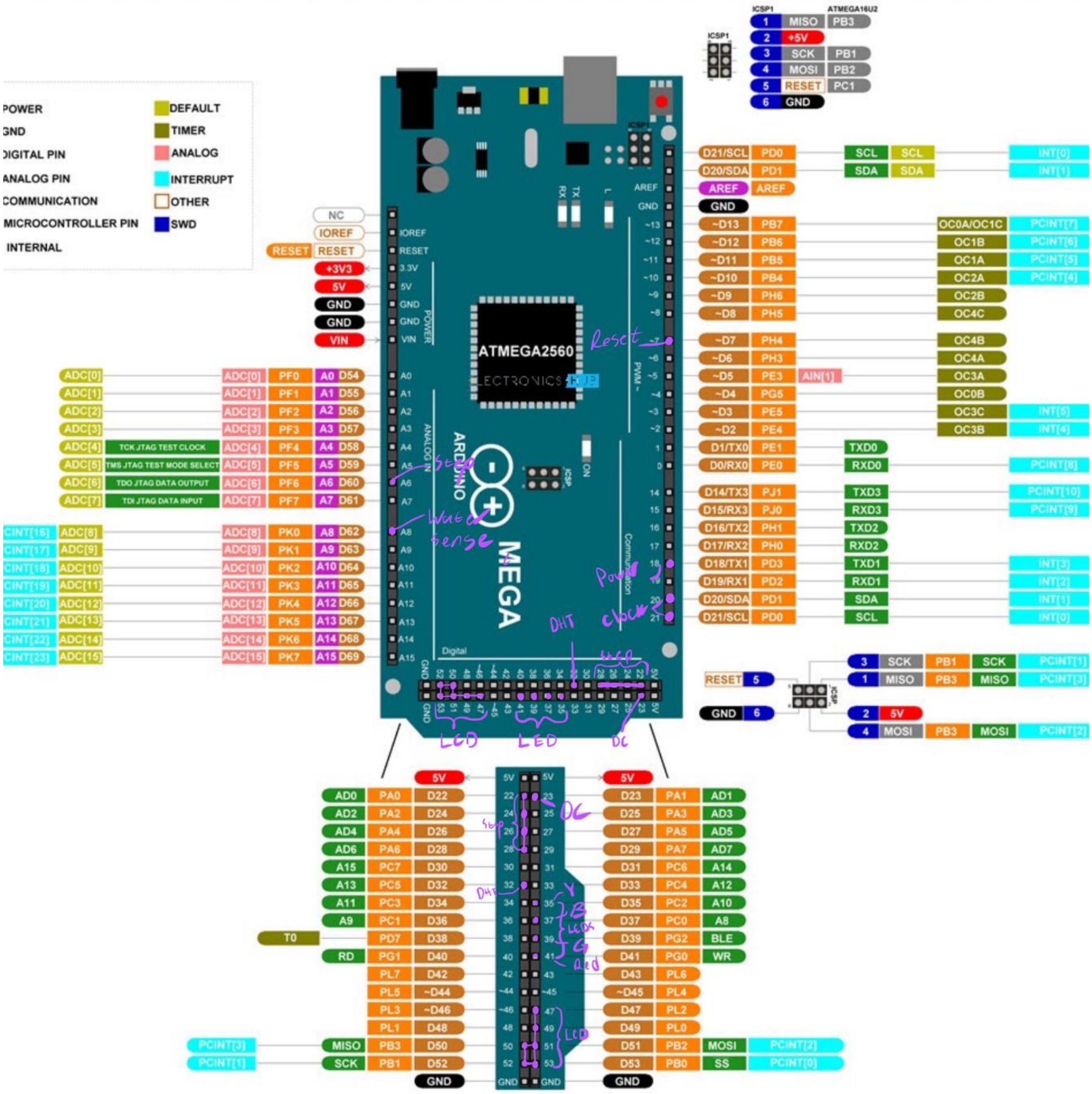
- 1 5V DC Stepper Motor
- 1 3-6V DC Motor
- 1 DHT11 Module
- 1 DS1307 Module
- 1 L293D Microchip
- 1 Water Level Detection Sensor Module
- 1 ULN2003 Driver Module
- 1 LCD1602 Module
- 4 LED's Red, Yellow, Blue, Green.
- 2 Potentiometers 10K

- 2 Push Buttons
- 1 6.5V – 9V Power Supply Module
- 1 AC Adapter
- 9 Resistors 330 Ohm
- 1 Fan Blade
- 1 Plastic Straw (to simulate Cooler Vent)
- 2 Breadboards 830 pin

Circuit Diagram:



MEGA Pinout


POWER
GND
DIGITAL PIN
ANALOG PIN
COMMUNICATION
MICROCONTROLLER PIN
INTERNAL
DEFAULT
TIMER
ANALOG
INTERRUPT
OTHER
SWD
ICSP1
ATMEGA16U2
ATMEGA2560
ARDUINO
MEGA
Reset
Power
clock
DHT
LED
DC

Data Sheets:

DHT11

https://www.mouser.com/datasheet/2/758/DHT11-Technical-Data-Sheet-Translated-Version-1143054.pdf

L293D

https://www.ti.com/lit/ds/symlink/l293d.pdf?ts=1715384208424&ref_url=https%253A%252F%252Fwww.ti.com%252Fproduct%252FL293D%253Futm_source%253Dgoogle%2526utm_medium%253Dcpc%2526utm_campaign%253Dasc-mdbu-null-44700045336317173_prodfolderdynamic-cpc-pf-google-wwe_int%2526utm_content%253Dprodfolddynamic%2526ds_k%253DDYNAMIC+SEARCH+ADS%2526DCM%253Dyes%2526gad_source%253D1%2526gclid%253DCjwKCAjwi_exBhA8EiwA_kU1MuxwCehYhonuvLhKs_ZRUEpA2LvSE5RYQFsnluqscMVwafi1VeXc4RoCVWYQAvD_BwE%2526gclsrc%253Daw.ds

LCD

https://www.waveshare.com/datasheet/LCD_en_PDF/LCD1602.pdf

RTC

https://www.sparkfun.com/datasheets/Components/DS1307.pdf

ULN2003

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

Water Level Sensor

https://www.biomaker.org/block-catalogue/2021/12/17/water-level-sensor-tzt-water-level-sensor

DC motor

https://www.osepp.com/accessories/motors/136-ls-00026-r260-3-6v-12000-rpm-brushed-dc-motor

Step Motor

https://www.mouser.com/datasheet/2/758/stepd-01-data-sheet-1143075.pdf

Power Supply

http://www.handsontec.com/dataspecs/mb102-ps.pdf