EECS 113 Final Project
Ambient Light Control/ Room Temperature(HVAC)/ Security System

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Kyle Mach
ID: 49437020
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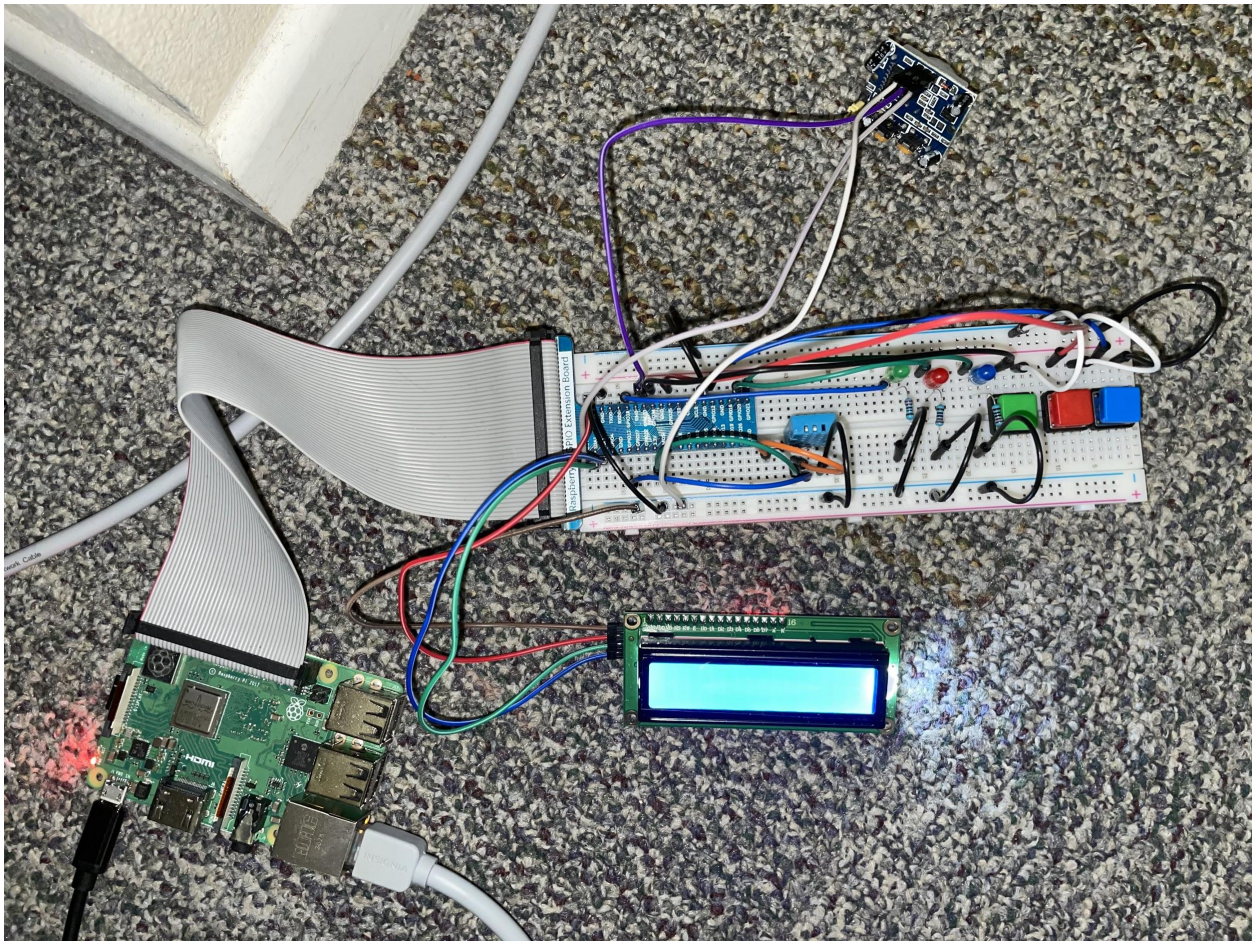
Introduction

The purpose of this project is to create a working system with an ambient light control, temperature system, and security system. The ambient light control has a PIR detect motion, which will turn on a green led and turn off after ten seconds of no motion. The temperature system takes in humidity from the California Irrigation Management System (CIMIS) and temperature from a DHT11 and displays the weather index on the LCD. There is also a heater and AC system that is controlled by the user through setting the desired temperature with a red button, which increases the desired temperature, and blue button, which decreases the desired temperature. When the weather index is 3 degrees above the desired temperature, the AC turns on, which is indicated by the blue led. When the weather index is 3 degrees below the desired temperature, the heater turns on, which is indicated by the red led. A message on the lcd will display for 3 seconds when the heater or AC is turned on or off. The security system is represented by the green button. When it is clicked, a message on the LCD will display “DOOR OPEN HVAC HALTED” or “DOOR CLOSED HVAC RESUMED” for 3 seconds. The green button will deal with both opening and closing the door.

Schematic/Screenshot



Description of Schematic/Screenshot

In this project I used the RPI.GPIO library to connect the circuit to my raspberry pi. The LCD is connected to SDA1, SCL1, 5V, and ground. The PIR is connected to GPIO 23, 3.3V, and ground. The DHT11 has 4 pins, where the vcc pin is connected to a 10k ohm resistor, which is connected to the signal pin on the DHT11.The vcc pin is also connected to the 3.3V source on the pi. The signal pin is also connected to the GPIO 17 pin. The ground pin on the DHT11 is connected to the ground on the pi. The 3 leds are connected the same way, with the positive side connecting to a GPIO pin and the negative side connected to a 220 ohm resistor that's connected to ground. The green, red and blue led are connected to GPIO 18, GPIO 20, and GPIO 21 respectively. The buttons are also all connected in the same way with one pin connected to a GPIO pin and the other connected to ground. The green, red, and blue buttons are connected to GPIO 24, GPIO 25, and GPIO 12 respectively.

Software Implementation

main.py

def displayLCD():

This function checks the global flags and prints the weather index, desired temperature, door status, heater status, AC status, and ambient light status on the LCD.

def getHVAC():

This function is called as a thread from main to get the temperature and humidity every second, then this function calls displayLCD() to print out the updated values every second. It also checks if the weather index is 3 degrees above or below the desired temperature and turns on the blue or red led, which represents the AC and heater respectively.

def checkSecurity(channel):

This function checks if the green button is pressed, and if so, the LCD will display "DOOR OPEN HVAC HALTED" or "DOOR CLOSED HVAC RESUMED" based on if the door was closed or opened for 3 seconds then go back to the displaying what displayLCD displays, but the HVAC will be halted until the door is closed again.

def raiseTemp(channel):

This function checks if the red button is clicked. If so, the desired temperature will increase, but won't go above the limit of 85 degrees.

def lowerTemp(channel):

This function checks if the blue button is clicked. If so, the desired temperature wil increase, but won't go below the limit of 65 degrees.

def checkPIR(channel):

This function checks if motion is detected or not from the PIR and turns on the green led if motion is detected. If motion is not detected for 10 seconds, the green led will turn off.

def timer():

This function gets the current time and keeps track of time for 10 seconds. If 10 seconds have passed, then this function will turn off the green led. If 10 seconds haven't passed and an event.clear() is triggered in the checkPIR function, then the green led will stay on.

cimis.py

def get_cimis_data (current_hour):

Based on the current_hour that is sent into this function, this function will set the current date, then it will call the function run_cimis to get the humidity data from CIMIS. After the data is received, it will create an object that stores the data received.

def retrieve_cimis_data(url, target):

This function opens the url given to it and retrieves the data from it. The data is stored in a variable and is converted to a json file. Then the function will return that json file to wherever it was called.

def run_cimis(appKey, station, start, end):

This function creates the url based on the appKey, station, start date, end date, and data items. Then it will call the function retrieve_cimis_data.

Ambient Light, HVAC, And Security Conditions Screen

This screen displays the following data:

- Weather index/Desired temperature- Shows on the LCD the weather index, which is obtained from the temperature sampled from the DHT11 and the humidity sampled from the CIMIS that is stored on their website, and the desired temperature, which is controlled by the user through a red and blue button. The weather index is calculated with the equation weather index = temperature + 0.05 * humidity
- Security system- shows if the door is open or closed and prints on the LCD “OPEN” or “SAFE” for if the door is open or closed respectively
- Heater/AC- displays on the LCD “OFF”, “HEATER”, or “AC” whether the heater and AC are on or not.
- Ambient Light- Shows on the LCD whether or not the green led is on or off

Security System Screen

- This screen is displayed for 3 seconds when the green button is clicked
- When the door is opened it will display “DOOR OPENED HVAC RESUME” instead

HVAC Screen

- This screen is displayed for 3 seconds when the AC turns on
- When the AC turns off “HVAC AC OFF” will be displayed
- “HVAC HEATER ON” and “HVAC HEATER OFF” will also display if the heater is turned on or off

References

Raspberry Pi Website:
https://www.raspberrypi.org/

CIMIS Website:
https://cimis.water.ca.gov/

Polling and Interrupts:
https://www.rototron.info/using-an-lcd-display-with-inputs-interrupts-on-raspberry-pi/

Multithreading in Python:
https://www.geeksforgeeks.org/multithreading-python-set-1/

Tutorial for LCD Setup:
https://www.youtube.com/watch?v=3XLjVChVgec

Tutorial for DHT11 Setup:
https://www.circuitbasics.com/how-to-set-up-the-dht11-humidity-sensor-on-the-raspberry-pi/

Tutorial for PIR Setup:
https://maker.pro/raspberry-pi/tutorial/how-to-interface-a-pir-motion-sensor-with-raspberry-pi-gpio