Richard Harrison

ECE 388 (Climate Control and Room Occupancy System)

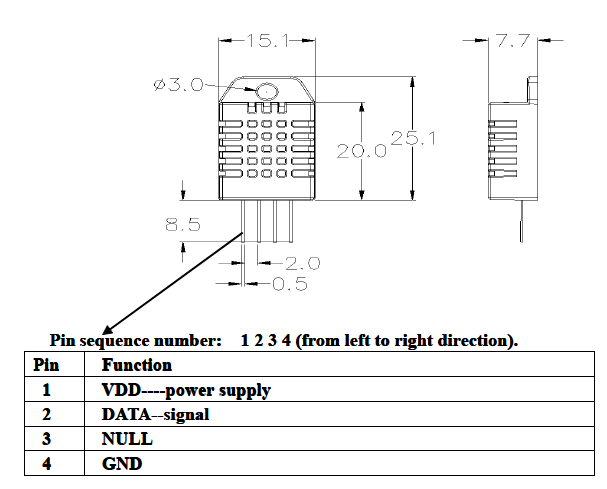
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Requirements

**Engineering:**

*Inputs/ Sensors:*

DHT22 Temperature and Humidity Sensor:

 The DHT22 is a digital temperature and humidity sensor that will provide all relevant readings of the room climate for the project. It is a 4-pin through-hole sensor, with the following pinout and dimensions:

The device is 15.1\*25.1\*7.7mm with a digital pinout that contains connections for power, output, an unused pin, and ground (provided by the ATMega328p), respectively. The operating range of voltage that the device requires is 3.3-6V (the sensor will use 5V, supplied from the ATMega328p), and the sensor can take a reading as quickly as every two seconds.

Interfacing with the device will be from pin #2 (signal) on the sensor to PD7 on the ATMega328p. Processing for the signal input comes from the DHT22 library provided by Adafruit. The default setting for temperature conversion is Celsius, but Fahrenheit display can be enabled as well.

C.J. SHOP IR Sensor:

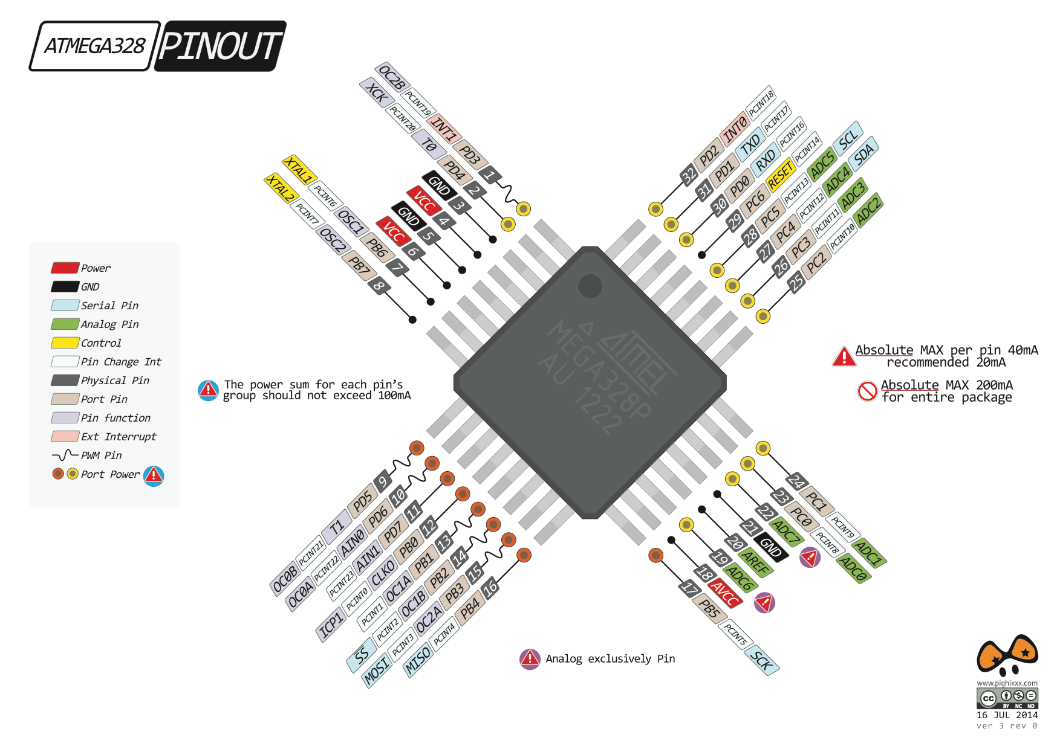
 Two C.J. SHOP IR sensors are the chosen motion sensors for the project. These 3-pin sensors will be mounted at the entrance and exit of the room and serve as a room occupancy estimator in which the entrance sensor will increment a counter that represents room occupancy and the exit sensor will decrement that counter. They will be mounted as breakout boards at the required areas and connect through two headers: the IR sensor at the entrance will connect to the PIR-IN header on the mainboard, and the sensor at the entrance will connect to the PIR-OUT header. The sensors’ pinouts are as follows: pin#1 is Vcc, which can accept 3.3-5V for power, pin#2 is ground, and pin#3 is OUT, which will provide the necessary digital interfacing with the ATMega328p. The sensors feature LEDs on board that shine when an object is detected. The range of the sensor is 2-30cm with a conical detection angle of 35°. It utilizes a potentiometer for range adjustment and the board has dimensions of 31\*15mm.

450-1129-ND Tactile Button:

 The project will utilize three 450-1129-ND buttons, two of which will serve as the interface between the user and the device. Those two buttons will be the temperature control; one button will increment the temperature setting, and the other will decrement it. The third button will be interfaced directly with the RESET pin on the ATMega328p and is not meant to be user accessible. The dimensions of the button are 11.2\*5.9mm. The push buttons do not require 5V power, only GND and connection to its respective incrementer/ decrementer pin on the ATMega328p.

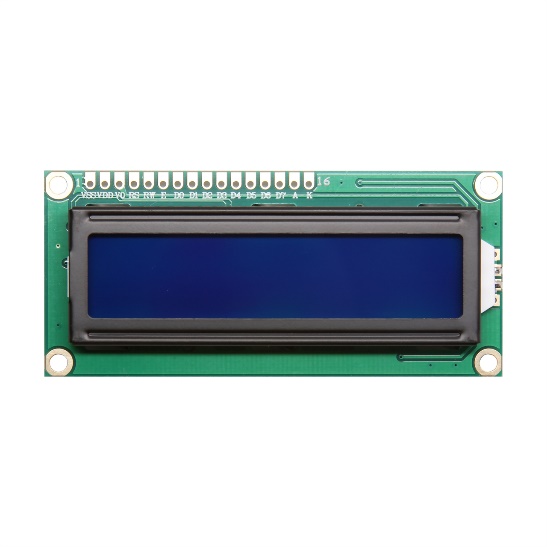
*Processing:*

ATMega328p:

The ATMega328p surface mount microcontroller will be doing all processing on board for this project. The 328p has 23 I/O pins and 32KB of memory on chip, which is sufficient for the storage of all code and related libraries for the project. The 328p accepts an input voltage of 5V, and can provide voltage and max current of 5V, 40mA per pin, with maximum total provided current of 200mA. Accompanying the 328p is the HC-49/UP 16MHz crystal, as the 328p does not contain one on chip. This is used for any timers that the programming will require.

*Outputs/ Actuators:*

1602A Character LCD:

The 1602A LCD is responsible for displaying three values: the current temperature of the room, the humidity of the room, and the desired temperature setting. It is a 16-column, 2-line display with support for a variety of letters and symbols that are useful for this project and dimensions of 80\*36\*11mm. The LCD panel contains sixteen pins for connection to the microcontroller, although for this project only twelve are used. The connection to the board is through the LCD header. Pins #1 and #2 are for ground and +5V of power. Current required for the LCD through VDD (+5V) is 1.1mA.

Honeywell HCE100R Heat Bud Ceramic Heater:

 The Honeywell HCE100R is the heating element for the project. It is a 250W heater that connects to 120V AC wall power, with input current of 2.1A. The dimensions of the heater are 105\*144\*165mm, making this the largest and most power-hungry part in this project by far. Because the power requirements for the heater are much higher than the system can deliver (the microcontroller can only deliver 5V DC, 40mA maximum), it will connect to a relay that switches the 120V AC power to the heater on rather than through the board.

40W Desk Lamp:

When the room is at maximum capacity, a 40-watt desk lamp will be used to visually indicate this. Once again, this lamp’s power requirement is far too large to be powered by the microcontroller (120V AC, .333A), so like the heater, the lamp will connect to a relay to switch 120V AC power rather than 5V DC.

12V Computer Case Fan:

For cooling, the system will utilize a 12V DC, .25A computer case fan to move air throughout the room. It will connect to the board using a JST and be switched using a MOSFET connected to 12V DC power from the board’s barrel jack.

**Consumer:**

The consumer requirements of the climate control and room occupancy system will consist of quite a few functions. The first function of the product is to read in the temperature and humidity of the room that contains the system. This information is outputted to the system’s 16\*2 liquid crystal display. As a climate control system, the product is meant to take in direct inputs from the user with two buttons: one that increments the desired temperature, and one that decrements it. This will be the user’s only method of interacting directly with the system; all other functions of the system will be either fully or semi-automated.

The second function of the system is a room occupancy estimator. Two IR sensors will be mounted at the entrance and exit of the room that contains the system. These two sensors are responsible for determining how many people are in the room using an automated counter on the system’s microcontroller. Limitations to the device’s accuracy will be mitigated by controlling the frequency of entry and exit to one that can be accurately tracked by the IR sensors. This will ensure that occupancy miscounts are rare, if ever. If maximum occupancy is reached, the system will shine a desk lamp, indicating this number has been reached. After that, the owner can determine how to lower the room’s occupancy (ie. directing occupants to the exit and denying entry to new guests), to which the light will shut off.