Temperature Plotter & Logger

Equipment Required :-

Item	Quantity
Raspberry Pi 4 Module B	1
MCP3008 ADC	3
PT100(2 Wire)	20
Connecting Wires	As required
3300 Ohms Resistor	20
5V Power Supply	4
Ethernet Cable	1
MicroSD Card	1
USB Drive(16 GB)	1
Breadboard(if required)	2

Information :-

PT100 is a RTD(Resistance Temperature Detector), made up of Platinum metal as it is resistant to corrosion and has positive coefficient of temperature, i.e, its resistance increases with temperature. 100 denotes that its resistance is 100 ohms at 0 degree Celcius. Similarly we get PT500, PT1000 etc. In this project we will be using PT100 as our temperature probe RTD.

PT100 comes as 2 wire, 3 wire and 4 wire. 2 wire PT100 is the basic RTD. 3 wire RTD eliminates the resistance of one the connecting wires that was incorporated as an error in the measurement, similarly a 4 wire PT100 eliminates the resistance of both the connecting wires and gives the resistance of just the Platinum element.

We require 20 of these 2-wire PT100s as we will be measuring temperatures of 20 refrigerators at once and one PT100 can be used in measuring the temperature of only one refrigerator at once.

A Raspberry Pi 4(or any other Raspberry Pi FYI) , unlike the Arduino UNO, doesnt have a built in ADC, therefore it cannot read analog values directly, therefore we need to use an external ADC with the Raspberry Pi to input analog values into the RPi. For this we will be using MCP3008 which is an 10 bit ADC with 8 channels, which means it can take 8 different analog inputs at a time and output 8 different Digital signals corresponding to those analog signals, though not at the same time, but serially one channel after another with a small time difference as there is only one data output port in the MCP3008, and each input analog signal can be divided into 2^10 levels, i.e. from 0 to 1023, the 10-bit property denotes the resolution of the ADC. We require 3 of these MCP3008s as we will be measuring temperatures of 20 refrigerators at once and one MCP3008 can take in analog inputs from only 8 x 2-wire PT100s, so in the end we will be left with 4 input ports of the last MCP3008 remaining.

I could have used MAX31685 instead of MCP3008, the former being more user friendly and a board, not just a microcontroller, but it has only 1 channel and therefore we will be needing twenty of these if we replace the MCP3008s with the MAX31685.

Only one Raspberry Pi is required for this project as there will be a total of 3 digital output channels from 3 MCP3008s. Raspberry Oi board allows us to use Hardware SPI and/or Software SPI, we will be using Hardware SPI. There are two SPI buses with two Chip select pins each. Two SPI devices can be connected to the Raspberry Pi 4 board using 1 SPI bus, therefore a total of 4 SPI devices can be connected to the Raspberry Pi 4 board, that is 4 MCP3008s can be connected to the Raspberry Pi 4 board. But since we have only 3 MCP3008s, we need only one Raspberry Pi 4 board.

The first two MCP3008s will use the SPI0 bus with CE0 and CE1 chip select pins respectively and the remaining MCP3008 will use the SPI1 bus with CE0 out of the available three chip select pins for SPI1(CE0, CE1 and CE2).

SPI0 is disabled by default and can be enabled using the Raspbian Configuration Window. SPI1 is enable by adding some text to /boot/config.txt file.

After acquiring all the equipment, we program the Raspberry Pi to perform the required task when all the connections to and fro the board have been made.

The program also automatically saves temperature values from individual refrigerators with the time stamps into separate CSV files which can be opened in excel or any other suitable spreadsheet software.

The program folder consists of two python files, one is the MCP3008 library python file and the second is our main python file.

Steps –

1. Acquire all the components.
2. Setup the Raspberry Pi.
3. Enable SPI 1 on the Raspberry Pi board.
4. Write the program files or copy it into a directory in the Raspberry Pi.
5. Make all the connections.
6. Run the program

Circuit Sketch –