runlinc Beginners Project 7: Temperature Controller (STEMSEL version)

Contents

Introduction

Problem

In some situations, it is very important to be able to control the temperature. We want to use our microchip to check and adjust the temperature.

Background

There are many situations where it is important to control the temperature. We use air-conditioning and heating to keep our homes at a nice temperature, and the fridge should be kept cold enough that the food doesn't spoil but not so cold that the food freezes. One application where it is even more important to control the temperature is in an incubator. An incubator is a container that has controlled temperature conditions that are used to keep the eggs or human babies until they can survive outside. If the temperature changes too much, then the baby or the chicks could die, so it is vitally important to control the temperature accurately.

Ideas

How can we check the temperature? What can we use to make it cooler? What about to make it hotter?

Plan

This project uses the STEMSEL controller board to maintain the temperature of a temperature sensor by either heating it with a light globe or cooling it with a fan. You may think it's strange to heat something up with a lightbulb, but the way a lightbulb works is to heat a tiny wire up until it glows to emit light. Because of this, lightbulbs give out even more heat energy than light energy!

Once again, we will need a threshold value, but how will we know what the temperature is? We can use the microchip first to check the initial temperature then keep the thermistor at that temperature. This will need to be done right at the start of the program, then we need to continually check how the temperature changes and turn on the lightbulb or fan as necessary.
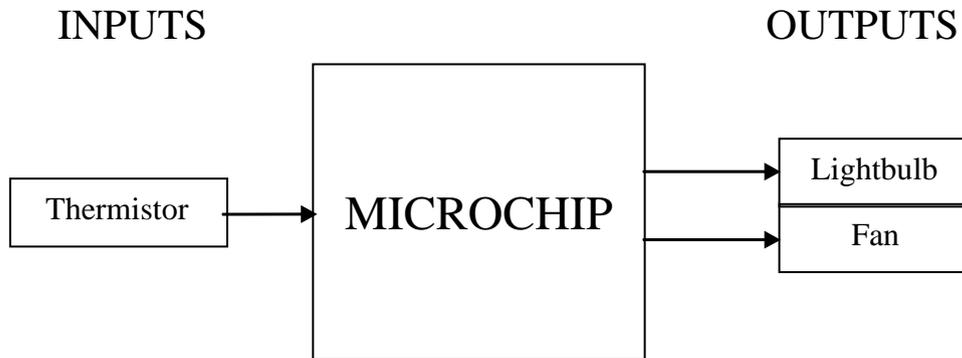
INPUTS   OUTPUTS

Thermistor → MICROCHIP → Lightbulb / Fan

Figure 1

Temperature

Hot

If the temperature is above the threshold turn on the fan and turn off the light bulb

Threshold

If the temperature is below our threshold turn on the lightbulb and turn off the fan
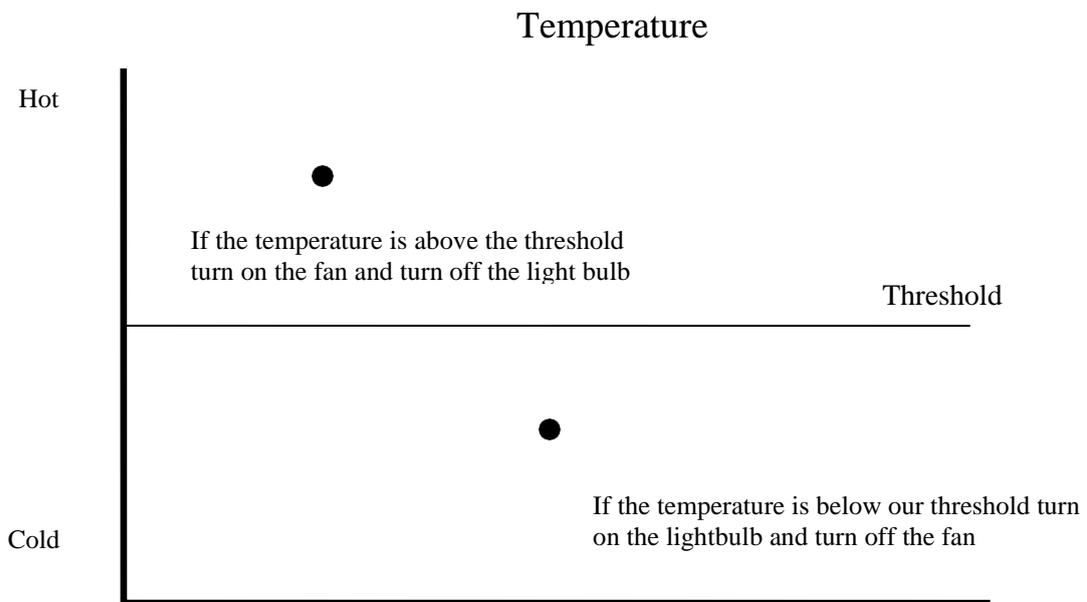
Cold

Figure 2

runlinc Background

Runlinc is a web page inside a Wi-Fi chip. The programming is done in the browser and sent to the chip over Wi-Fi. The runlinc web page inside the Wi-Fi chip will command the microchips to do sensing, control, data logging Internet of Things (IoT). It can predict and command.

Part A: Design the Circuit on runlinc

Note: refer to runlinc Wi-Fi setup guide document to connect to runlinc

In our circuit design, we will be using a lightbulb, fan and heat sensor.

For port C4, we name it Lightbulb and set it as DIGITAL_OUT

For port C5, we name it Fan and set it as DIGITAL_OUT

For port C7 we name is Heatsensor and set it as ANALOG_IN

PORT	CONFIGURATION	NAME	STATUS
A3	DISABLED		
B4	DISABLED		
B6	DISABLED		
C0	DISABLED		
C1	DISABLED		
C2	DISABLED		
C3	DISABLED		
C4	DIGITAL_OUT	Lightbulb	OFF
C5	DIGITAL_OUT	Fan	OFF
C6	DISABLED		
C7	ANALOG_IN	Heatsensor	0

Part B: Build the Circuit

Use the runlinc I/O to connect the hardware. Remember that black wires connect to the negative port (-), red wires to the positive port (+) and white wires connect to the pin designated in the circuit design.
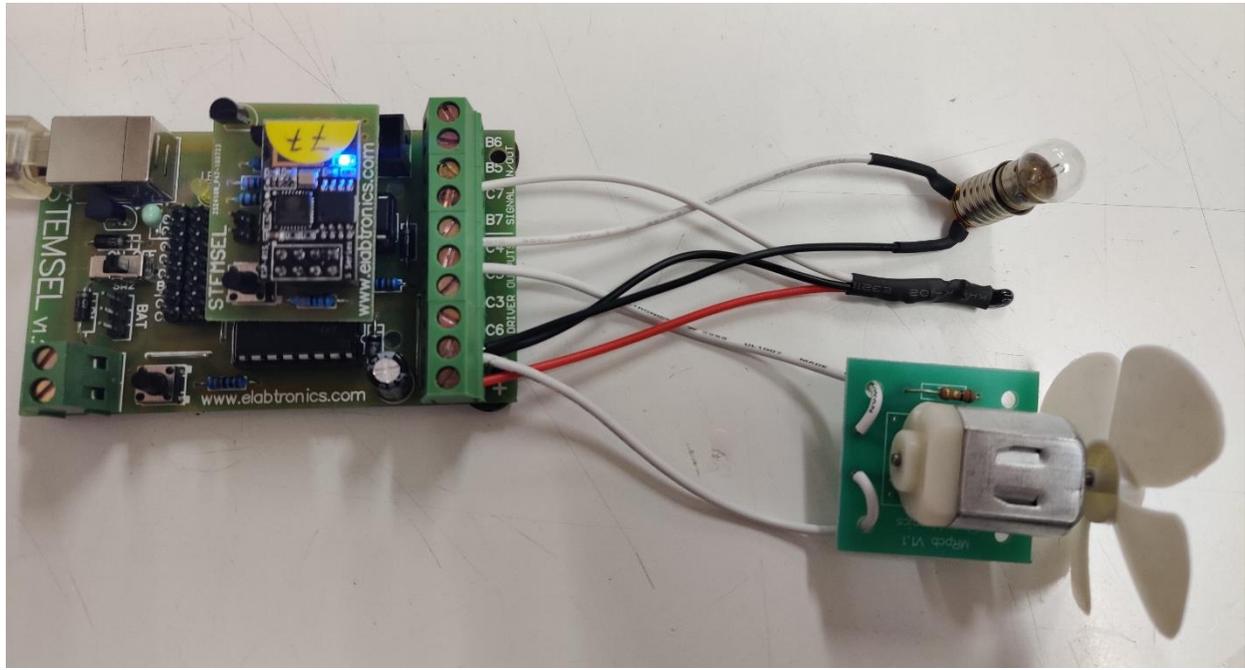
Wiring instructions

a.) Connect the light bulb black to (-) and white to port C4

b.) Connect the DC Motor one white port to negative (-) and other white to port C5

c.) Connect the heat sensor red wire to positive pin (+), black wire to negative pin (-) and white to port C7

Part C: Program the Circuit

Use the blocks on the right side of the runlinc webpage to program the functions of the temperature controller. Use the HTML to add contents, CSS to add style to your taste and JavaScript to program the microchip. For this case, HTML, Javascript, JavaScript Loop is needed to program it to act as a temperature controller. Type the following code.

HTML

```
Result = <label id= "Temp"></label>
<br>
Intial_temp  = <label id= "Init"></label>
```

JavaScript

```
TurnOn(Lightbulb);
Intial_temp = analogIn( Heatsensor );
Intial_temp = Intial_temp + 2;
```

JavaScript Loop

```
Result = analogIn( Heatsensor );
document.getElementById("Temp").innerHTML= Result;
document.getElementById("Init").innerHTML= Intial_temp;
if (Result < Intial_temp){
   turnOn( Lightbulb );
   turnOff ( Fan );
}else{
   turnOff ( Lightbulb);
   turnOn ( Fan );
}
await mSec( 1000 );
```

Extension

Currently the temperature controller has only one single set point. It means that either the globe heater or the fan cooler is on at any one time which is wasteful of energy. Less energy will be used if the controller has upper and lower temperature set points. Modify the program so that the heater is only on when the temperature is below the lower temperature set point and the fan cooler is only on when the temperature is above the upper temperature set point.
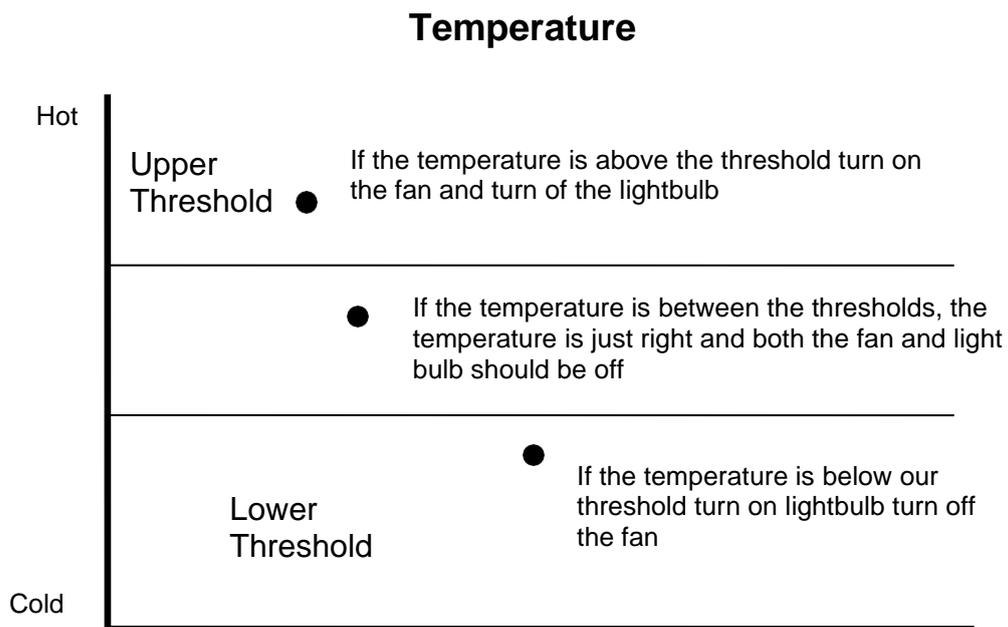
Temperature

Hot

Upper
Threshold ● If the temperature is above the threshold turn on the fan and turn of the lightbulb

● If the temperature is between the thresholds, the temperature is just right and both the fan and light bulb should be off

● If the temperature is below our threshold turn on lightbulb turn off the fan

Lower
Threshold

Cold

Figure 6

Summary

Although it is uncomfortable for us to be too hot or too cold, for a baby, it can easily be life-threatening. Therefore the incubators that keep them alive must have very accurate temperature control. Our temperature controller turns on a lightbulb to heat the incubator, and uses a fan to cool it down again..