STEMSEL Beginners Project 5: Fridge Alarm

Problem

Fridges only work when the door is closed. We need to create an alarm that will tell us if the fridge door has been left open.

Background

Fridges have become necessary in our daily lives. By keeping our food cold we can keep food fresh for longer. Previously it was necessary either buy perishable foodstuffs every day, or to preserve them which was very time consuming. The invention of the coolbox was useful, but it still required large blocks of ice to be bought periodically to keep the food cold, since there was no electricity. Now we can buy food and keep it fresh in the fridge for days. Fridges also keep pests like mice and cockroaches away from our food which prevents disease. However, if the fridge door is left open the fridge can't keep the food cold and fresh, and the pests can get at our food!

This project constructs an alarm that sounds when the fridge door has been left open. An extension also checks the temperature in the fridge and sounds an alarm if the temperature gets too high. It uses the STEMSEL controller board, a Light Dependent Resistor (LDR), a yellow LED, a buzzer and a Temperature Sensor. When the fridge door is opened the LDR senses the light in the fridge and activates a buzzer and a LED as a "door open" alarm.

Ideas

How can the microchip tell if the fridge door is open? What differences are there between when the door is open and when it is closed? Do we want the alarm to activate as soon as the door is opened or should we have a delay? How can the alarm let us know that the door is open?

Plan

There are two things that might change when the door is open: the light level and the temperature. In our kits we have light sensors (LDRs) and heat sensors (thermistors). We can use both of these to check if the door is open. When the alarm turns on, we will activate a buzzer, but what if both the light and temperature levels are above the safe threshold? We will also use an LED to show that just the temperature is too high.

Light level

Bright

● If the light level is above our threshold, the
   door is open and the alarm should be on.

Threshold

● If the light level is below our threshold, the
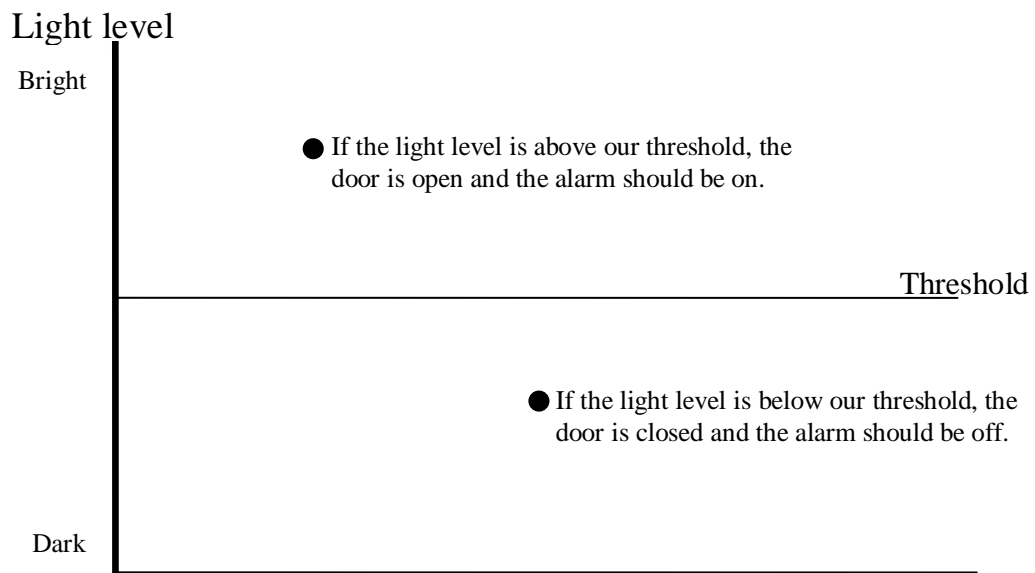   door is closed and the alarm should be off.

Dark

Figure 1

Temperature will work in the same way; if it is above the threshold the alarm should be on, otherwise the alarm should be off. The microchip should continuously check the light and temperature levels, then activate the alarm if either of them get too high.
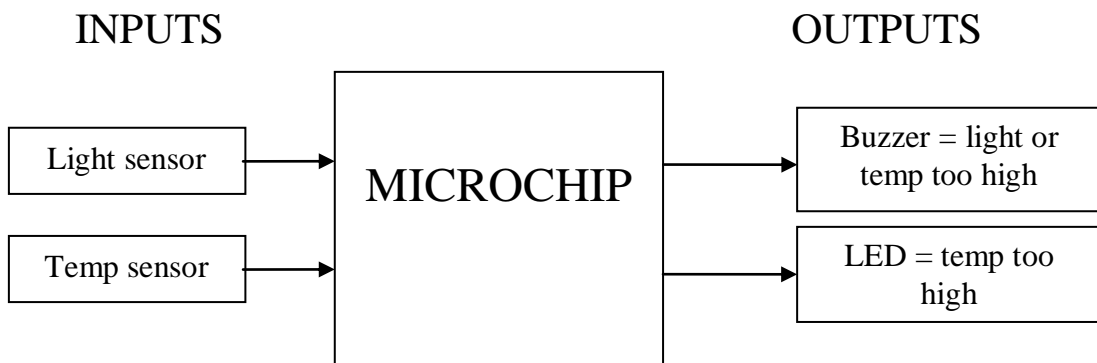
INPUTS   OUTPUTS

| Light sensor | → | MICROCHIP | → | Buzzer = light or temp too high |

| Temp sensor | → | | → | LED = temp too high |

Figure 2

Design the Circuit

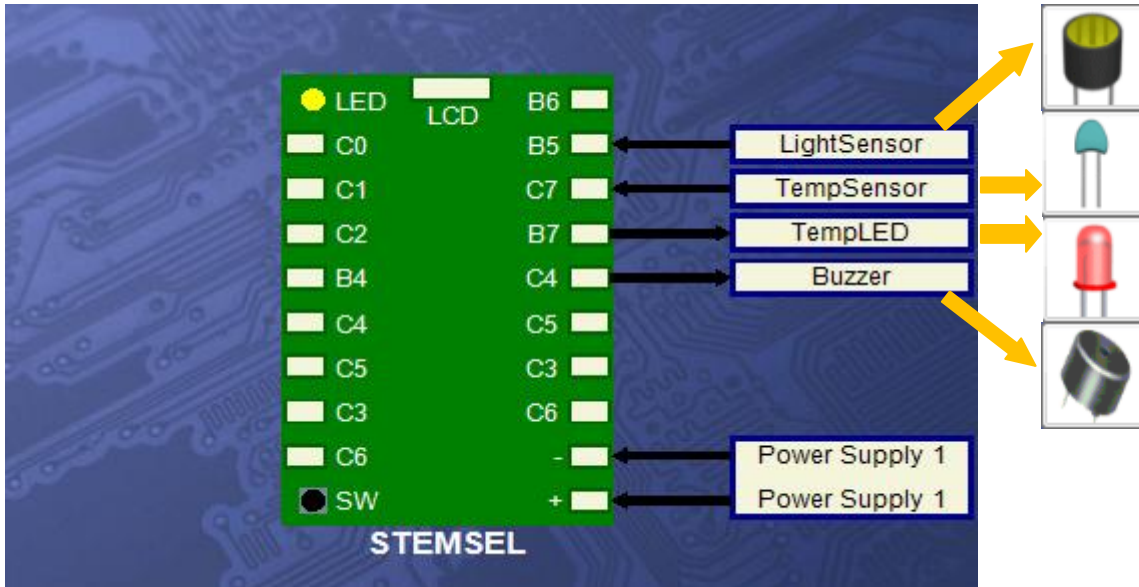Use ezCircuit Designer to construct an input/output (I/O) diagram. Remember to right click to rename the components.

Figure 1

Build the Circuit

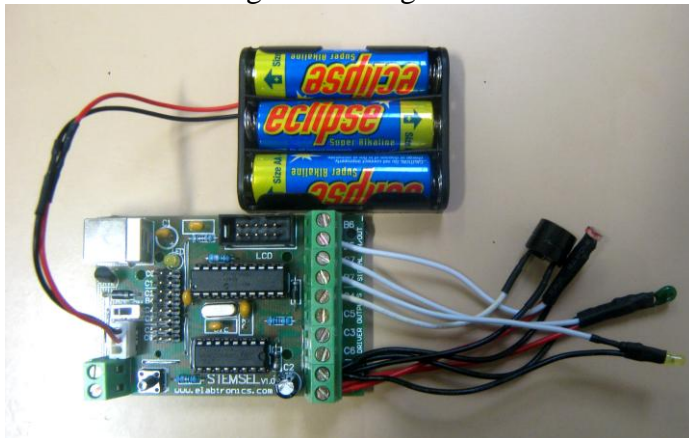Use ezCircuit Designer I/O diagram to connect the hardware.

Figure 2

Wiring Instruction

Temperature Sensor, Red to "+", Black to "-" and White to C7

Light Sensor, Red to "+", Black to "-" and White to B5

LED White to B7 and Black to "-"

Buzzer White to C4 and Black to "-"

Programming

We will use CoreChart to program the functions of the fridge alarm. After you have used the test routines to check the outputs, delete them so that we can start writing our own program. We will just use the light sensor to start with.

1. According to the plan, the microchip should first check the light level. Click the Inputs button, and use an AnalogIn icon to get the reading from the LightSensor.

2. Compare this reading with the threshold value of 3V. Make sure you tick the Above and Below Checkboxes.

3. We can see from the graph we made in the plan that if the light level is below the threshold it is dark in the fridge, so the door must be closed. Our alarm devices should not be on, so use OnOffPin icons to turn the buzzer and LED off.

4. If the light level is above the threshold it is light in the fridge, so the door must be open. Our alarm devices should be on, so use OnOffPin icons to turn the buzzer and LED on.

5. Group the OnOffPin icons together so that they fit beneath the decision icons.

6. Finally, we need a GoTo START icon so the microchip keeps checking if the door is open or closed. Your finished program should look as follows:
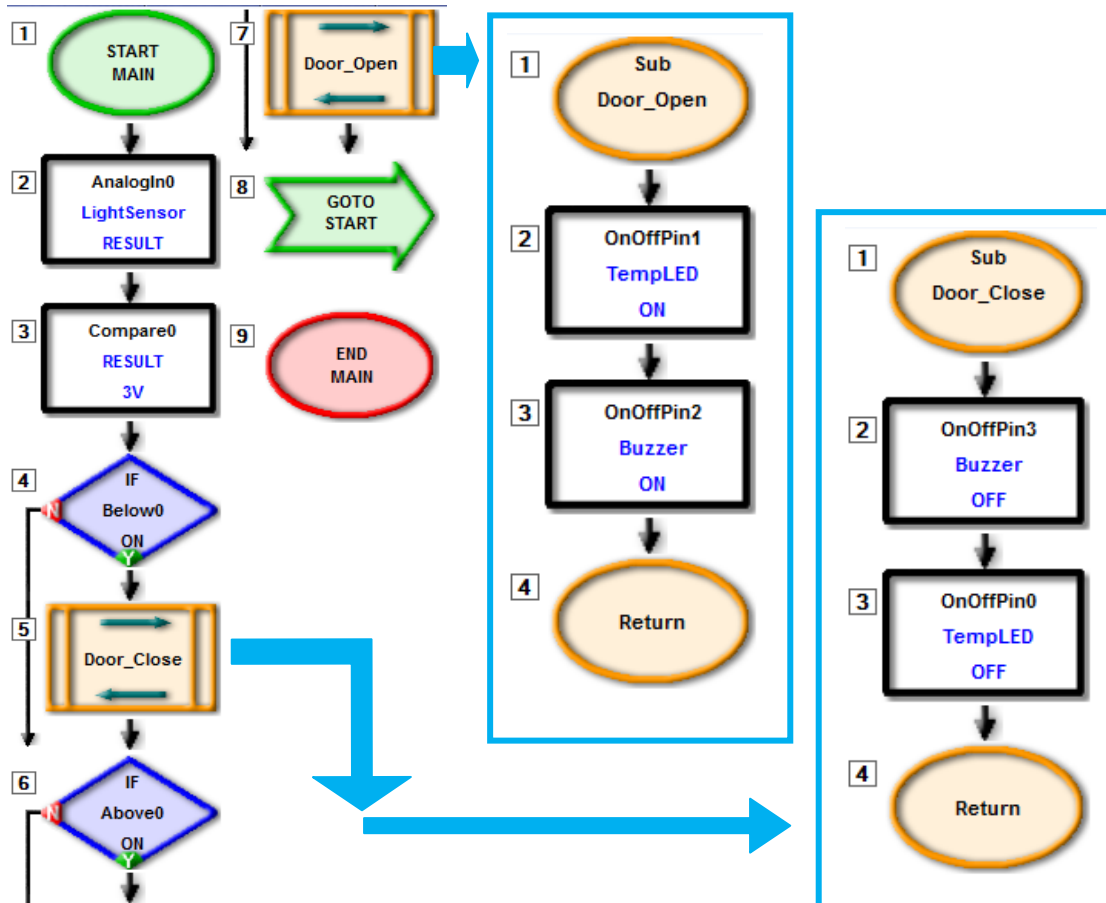

Figure 3

Extension

1. Modify the fridge alarm program so that the alarm is activated after the fridge door has been opened for more than five seconds. The time delay of five seconds should only occur when the door is opened and not any other time in the program.
Hint: The subroutine group called "Door_Open" is a good place to make this change.

2. If the power goes out, then the temperature will start to rise in our fridge even if the door is closed. Add the temperature sensing feature so that when the temperature is above a set point the buzzer and the "TempLED" will turn on. The system will still continue to check if the door is opened even when the temperature alarm is activated.
Hints:
The program for the temperature alarm is similar to the part of the program for the door open alarm using the LDR as light sensor.

Create a subroutine group of all the icons used for the door open alarm called "Check_Door" so that the program is easier to understand.

Important: The set point value of the temperature sensor will need to be adjusted depending on the room temperature. Start with a "compare with" value of 1.0.

Summary

The electric fridge is a highly useful device, but it must be used properly otherwise we waste electricity and run the risk of illness from spoiled food. Our fridge alarm will warn us if the fridge is left open too long, and also if the temperature gets too high in the fridge.