STEMSEL Automotive Project 2 – Radiator/Fluids Low Indicator

Problem

Petrol isn't the only fluid our cars require, and if they run out of water or oil it can seriously damage the car. In this project we will make a water level detector to sound an alarm before it runs out.

Background

A cars engine produces a lot of heat, and if the engine gets too hot it can cause serious damage. To account for this a cooler system is used which pumps cold water or oil through the engine to help remove the heat. If this tank runs out of water or oil, the car is sure to overheat and cause all sorts of issues. Therefore, this tank requires a way to indicate if its level is low or empty so the driver can fill the tank.

Ideas

What do we have that can be used to indicate the level of a tank? Let's say the tank only has three levels; full, low or empty. How could we distinguish between these levels? Think about how the Human Conductor tutorial worked and how we could use the same idea in this tutorial. What do we have that could be used to indicate to the driver what level the tank is current at?

Plan

To represent the tank we will use a cardboard cup. On the cup mark a line about 2cm from the base. When the water is above this mark Green LED will be on indicating that the tank is FULL. When it is below the Yellow LED will be on indicating that the tank is LOW. When the cup is empty the Red LED will be on indicating that the tank is DANGEROUSLY LOW. Now get a long piece of wire and poke it through the cup where you made the mark. Be careful to make the hole as small as possible and then cover it with some tape. Be sure that the wire is still exposed inside the cup though. Now do the same for two wires very close to the bottom of the cup, be careful that they are not touching each other. One of the bottom wires will be a transmitter wire, and the other two will be receiver wires.

When the cup is full there will be water covering the top receiver wire and both of the bottom wires. When this is the case, there will be a voltage across the top receiver wire and the bottom transmitter wire. This will indicate that the Green LED must be turned on. Now carefully remove some of the water in the cup until the top wire is no longer covered. At this point only the bottom two wires are underwater, therefore there will be a voltage across them. This, and no voltage across the top receiver wire and bottom transmitter wire, will indicate that the Yellow LED needs to be turned on. Now pour all of the water out of the cup, so that there will now be no voltage across the transmitter wire. This will indicate that the Red LED needs to be turned on as the tank is out of water.

When the circuit is completed by water touching both of the wires, the voltage on the receiver pin will increase. As we have two receiver pins, we will need to set two threshold values. Let's set the threshold for the top FULL receiver to 4V. When the voltage on the top receiver wire is above this threshold of 4V the microchip will know that the circuit is complete and needs to show FULL. When the voltage at the top receiver drops below 4V, but the voltage on the bottom receiver is above 4V, LOW needs to be shown. Now let's set another threshold for the bottom receiver to also be 4V. This

means that when the voltage at the bottom receiver is below 4V, DANGEROUSLY LOW has to be shown.

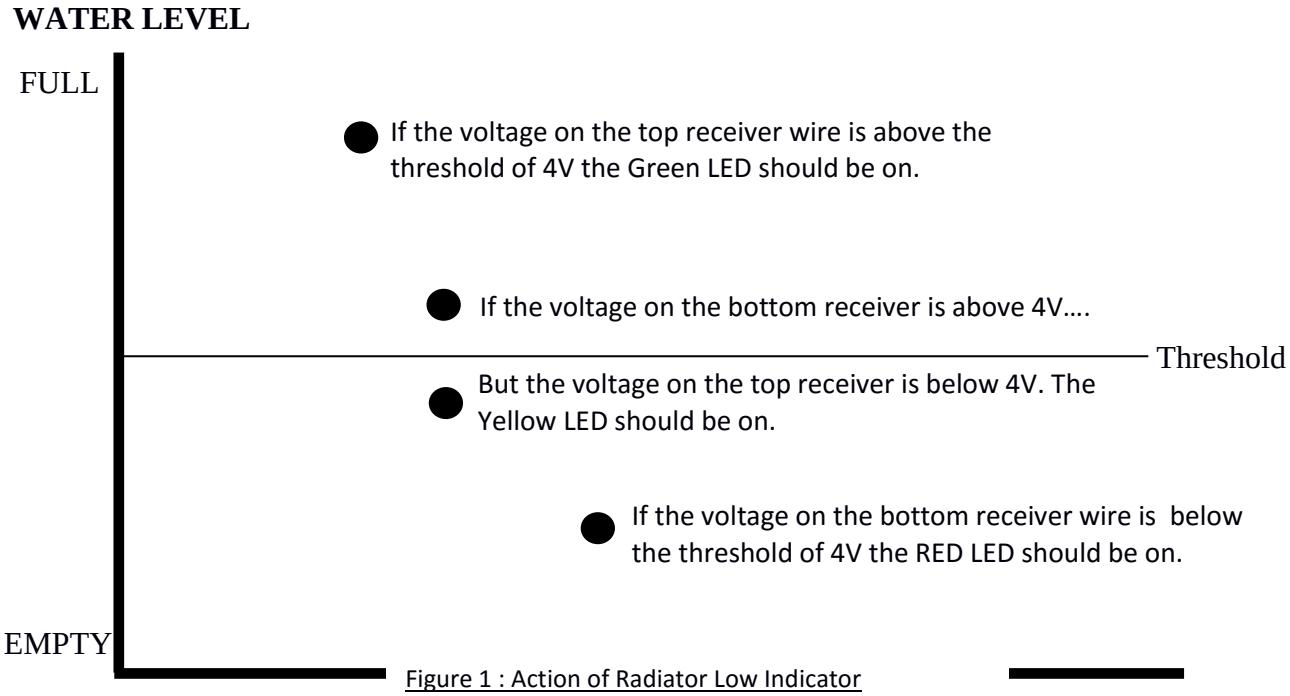

Figure 1 : Action of Radiator Low Indicator

Design

Open ezCircuit and create a new project called Radiator_Low_Indicator. From the plan we can see that on this board we will need the Green, Yellow and Red LED's, two receiver wires and one transmitter wire. All three of these wires should be at least 20cm long. The wires don't have a special icon so these need to be added in a different way. For the two Receive_Wires click the input button, and then select **Analog Input** from the circuit lists. For the Transmit_Wire click the Outputs button and select **PWM output** from the circuit list. Be sure you know which wires are which, perhaps use a different colour for the transmit wire (not black or red as they are reserved for negative and positive, respectively).

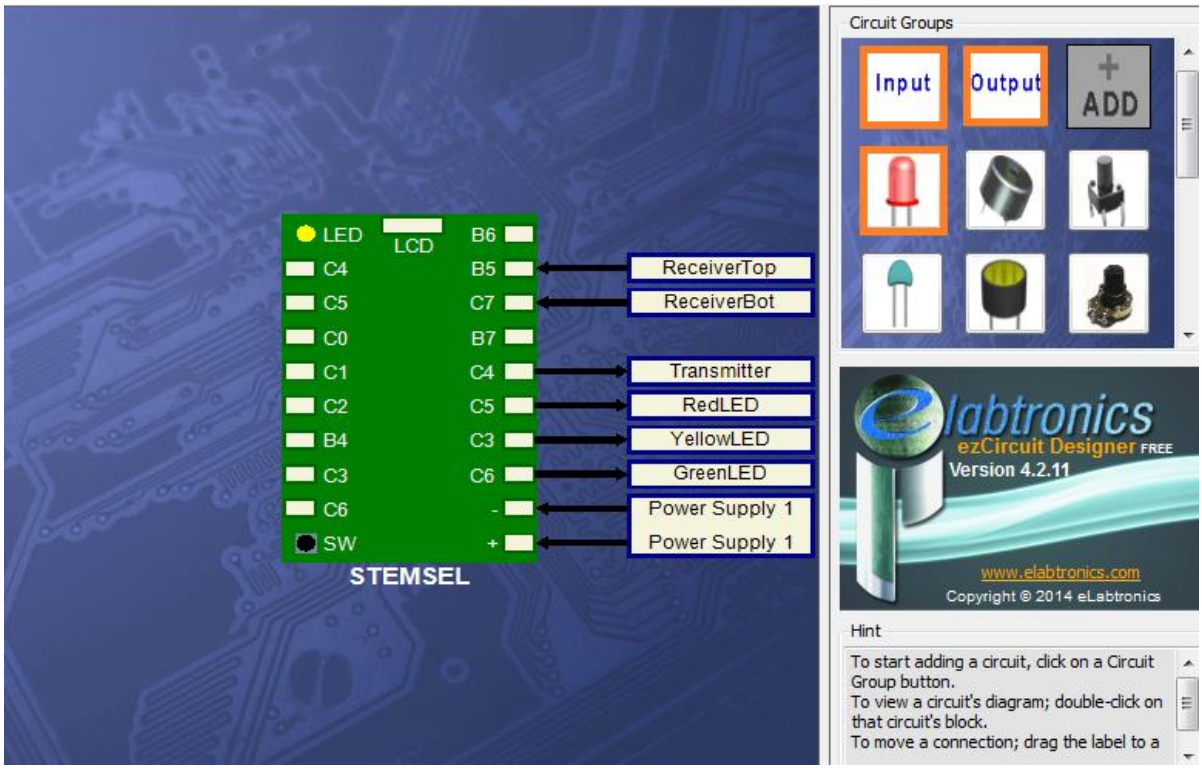

Figure 2: circuit design

Build the circuit

When you are finished the design, it's time to assemble the circuit using your kit. Using the ezCircuit diagram connect the LED's, the transmitter wire and the two receiver wires to the STEMSEL board. If you have trouble fitting 3 negative wires in the negative port either move one of the wire to the other negative port or use the built in yellow LED instead of the attached one.

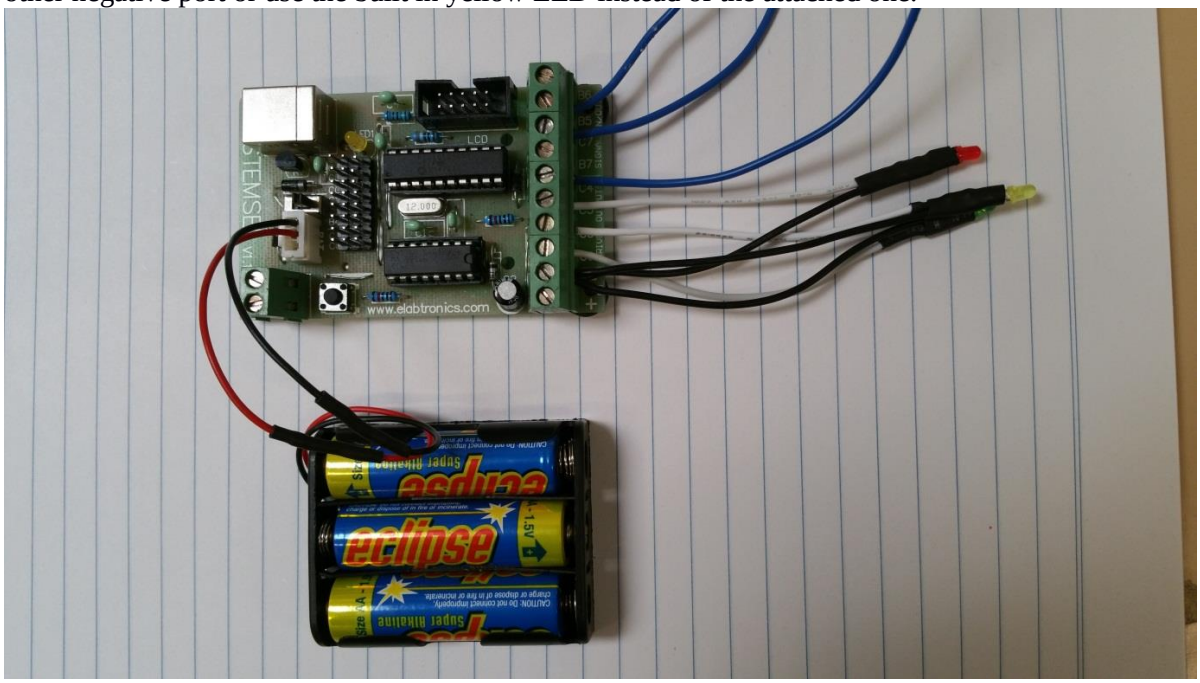

Figure 3 : Completed circuit

Programming

Once you have assembled the circuit, send the design to Corechart by clicking the "Send to Corechart" button, then click the "Send Program To Chip" button to program the microchip with the test routines. Once you done the test routines, delete them so we can create our own program.

The steps below will help you create your program:

1. First we need to make sure the transmitter has power flowing through it. In Outputs, use an OnOffPin to turn "Transmitter" to ON.

2. We want to be receiving the voltage values that the receiver wires are obtaining. So in Inputs, use two Analog_In icons. One will store the value of the top Receiver. Name this "UpperVolts". The other will store the value of the bottom receiver. Name this "LowerVolts".

3. Before we get into the logic of when to turn each LED on, first we will make three separate addresses which turn the LED's on and off. Create an address by clicking address. Name this address "Green_On". Now use 3 OnOffPin icons to turn the GreenLED to ON and turn the other two LED's to OFF. Make two more addresses named "Yellow_On" and "Red_On" and repeat the same process except it "Yellow_On" the Yellow LED will be on and in "Red_On" the Red LED will be on. At the end of each of these address routines, place a GOTO START. This will ensure that the program doesn't just run once and end.

4. Now we have to compare the value of the Top Receiver with our threshold value to see what level the cup is at. In Numbers, use a Compare icon to compare "UpperVolts" with a voltage value of 4V, our threshold. Click the Above option. If the Top Receiver is above 4V this means that the fluid in the cup is FULL, so we want to use our "Green_On" subroutine. To do this, use a GOTO and select "Green_On".

5. Next we have to compare the value of the Bottom Receiver with our threshold value to see what level the cup is at. In Numbers, use a Compare icon to compare "LowerVolts" with a voltage value of 4V, our threshold. Click the Below option. If the Bottom Receiver is below 4V this means that the fluid in the cup is DANGEROUSLY LOW, so we want to use our "Red_On" subroutine. To do this, use a GOTO and select "Red_On".

6. The last situation is if the Top receiver's value is below 4V but the Bottom receiver's value is above 4V. This situation means that the fluid in the cup is LOW. Since we have already dealt with all other possibilities we don't have to compare anything else. Simply place a GOTO "Yellow_On" after the other two comparisons have been completed. We can do this as if the value is not just below, or just above, it can only be one other option. This is the LOW option.

7. Below is a diagram of the completed program.

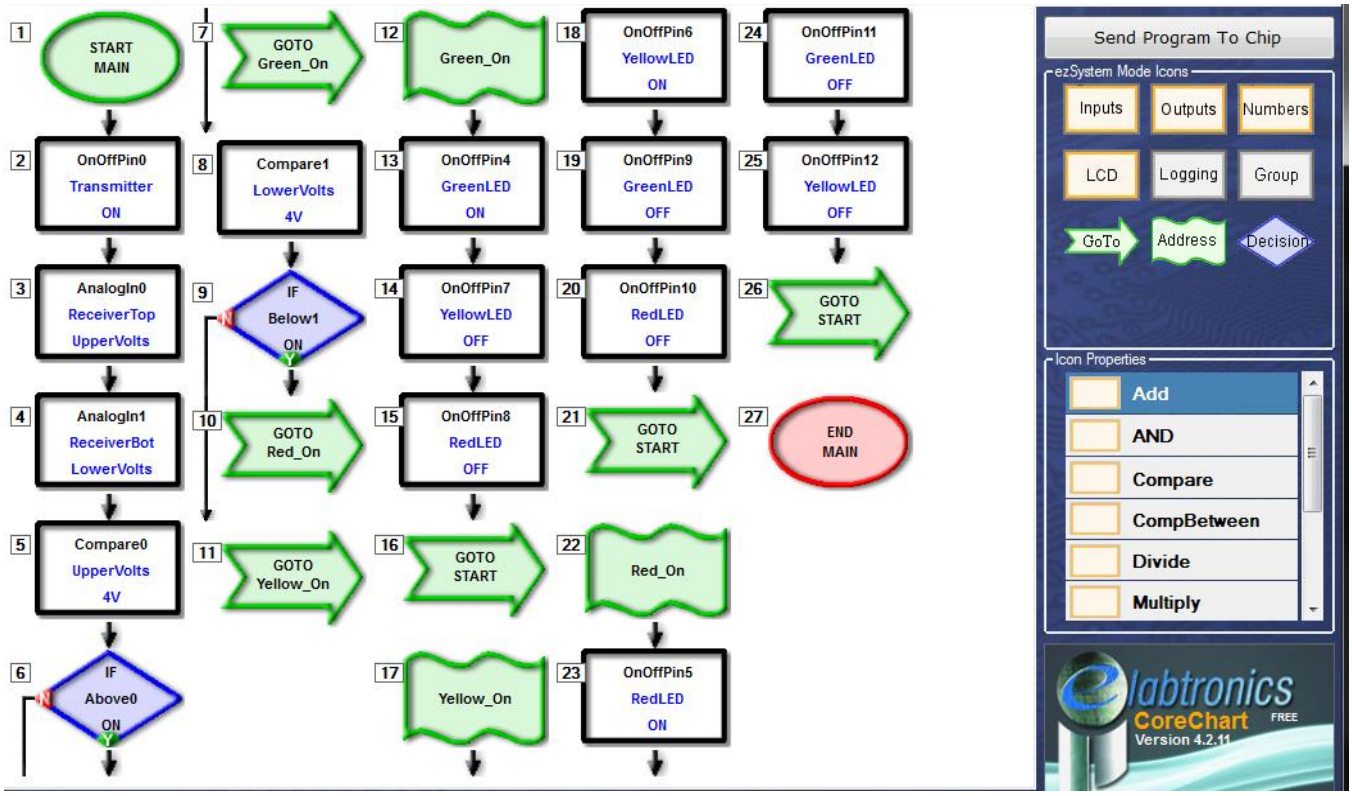

Figure 5: completed program

Activity/extension

Although warning lights are good to notify someone if their tank is running low, they might not always see them with all the other lights and notifications on a car dashboard. What other car notifications are there in a car? If you have a newer car, what happens if you start driving and your seatbelt isn't on?

Use another piece of hardware in your kit that would give the driver another form of feedback besides visual to warn them that the tank is DANGEROUSLY LOW.

Summary

By using some wires, LED's and a microchip, we were able to measure the level of fluid in a cup. During this project, we learned how we can use the microchip to compare the voltage of wires in a liquid. Although this project only used a small cup, the principles can be applied to a real car's dashboard and radiator/fluid tank. This is a connection of SEL. A small project that teaches how to turn some LED's on and off and program a microchip can be applied to real world applications to improve industry and improve the life of people around the world.