

# STEMSEL Intermediate Project 4: Eyes for the Blind

## **Problem**

Most of us take our eyes for granted, even though we use them every day. People who have lost their sight may find it difficult to do many things, so we want to create a light sensing device that they can use.

## **Background**

Everyone knows what eyes are that we use them to see the world around us. But have you ever wondered how they are able to do that? Watch the following videos to learn more about the eye and how it works:

<http://www.youtube.com/watch?v=kNuSm5l-5M8> (eye Structure)

<http://www.youtube.com/watch?v=gvozcV8pS3c> (Journey Through eye)

<http://www.macular.org/humaneye.html> (More about eye structure)

Eyes are organs that detect light and send that as a signal back to the brain which then assembles the light into a picture we can understand. The eye is actually made up of several parts, each with their own function. The light enters via the pupil, and is focused into a nice clear image by the cornea and lens. The iris controls how much light enters our eye by changing the size of the pupil. The focused light then shines on the back of the eye which is called the retina which converts it into a signal which travels to the brain via the optic nerve.

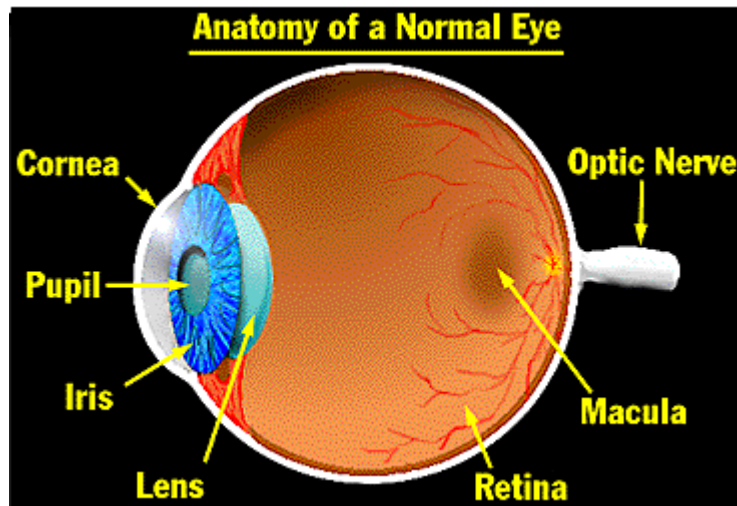


Figure 1: Anatomy of a Normal eye

Sometimes our eyes can become damaged by disease or defect, and we become blind. Although we often think of blind people as not being able to see at all, many blind people are able to see a little, but not enough to let them live normally without assistance, for example a cane to feel obstacles in the road, or a guide dog to help them walk around. Also, when people lost one sense such as sight, their other senses often become better. For example, some blind people's hearing becomes so good that they can echolocate like a bat does, so that they can hear obstacles in their way and avoid them. Click the following link to see a video about a boy who was able to do this:

<https://www.youtube.com/watch?v=qLziFMF4DHA> - (the boy who sees without eyes).

Unfortunately, most blind people are unable to do this, so they still rely on other things for assistance, like the canes and guide dogs mentioned before. In this project we want to help them by making a light sensing device.

## Ideas

How can we make our device see the light that the blind person can't? How can the device tell the blind person whether the light is to the left, right or straight ahead? Can we use LEDs, or do we need something else?

## Plan

Eyes detect light and send a signal to the brain. The STEMSEL microchip is like a brain, and we also have LDRs in our kits that can detect light. We will also need some way to let the blind person know when they are pointing directly at the light. LEDs or the lightbulb are clearly no good for this, because the blind person can't see them, so instead we can use a buzzer to make a noise.

We will use both LDRs, and place them at a 90 degree angle to each other so that the blind person can tell where the light is coming from. In the program we will compare the light level from the right LDR with the light level from the left LDR. If the light is to the person's right then the voltage on the right LDR will be higher, and similarly if the light is located to the person's left then the voltage will be higher on the left LDR. If the light levels are the same then the light source is directly in front. An angle of 90 degrees gives the widest angle of view.

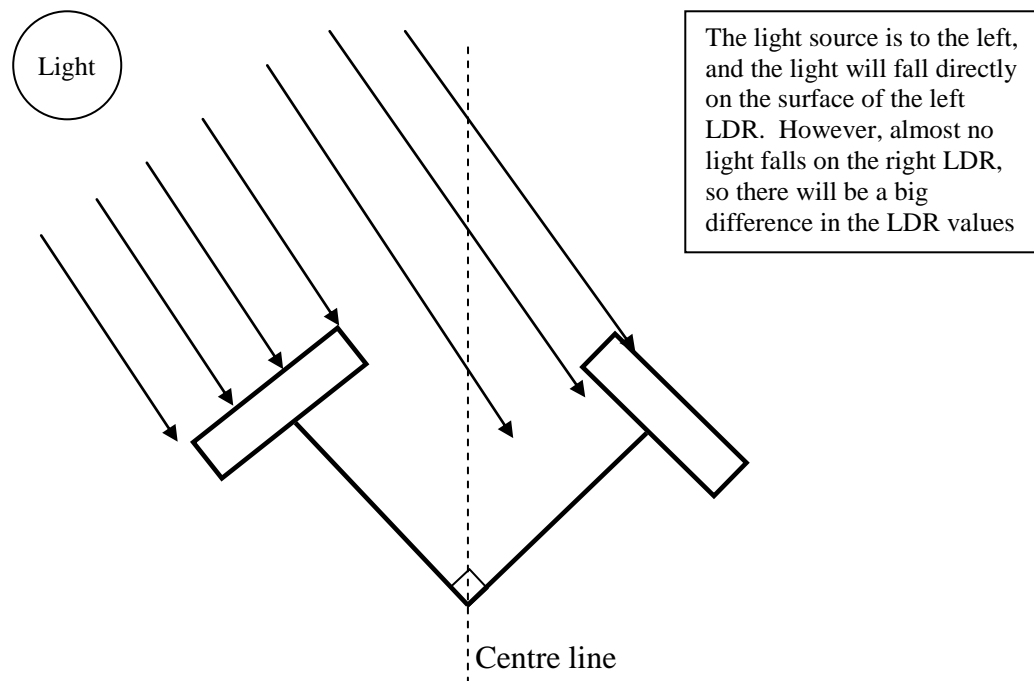


Figure 2: LDR alignment

By setting the buzzer to beep only when the LDR on the left is receiving more light than the one on the right, the blind person should be able to walk towards a light source by trying to find the point where the buzzer switches from on to off, or vice versa. At this switching point the light source is directly ahead.

## Design

Open ezCircuit Designer and add two LDRs and a buzzer to the circuit like we specified in the plan. Rename the LDRs as Left and Right so that we know which one should be pointing in which direction.

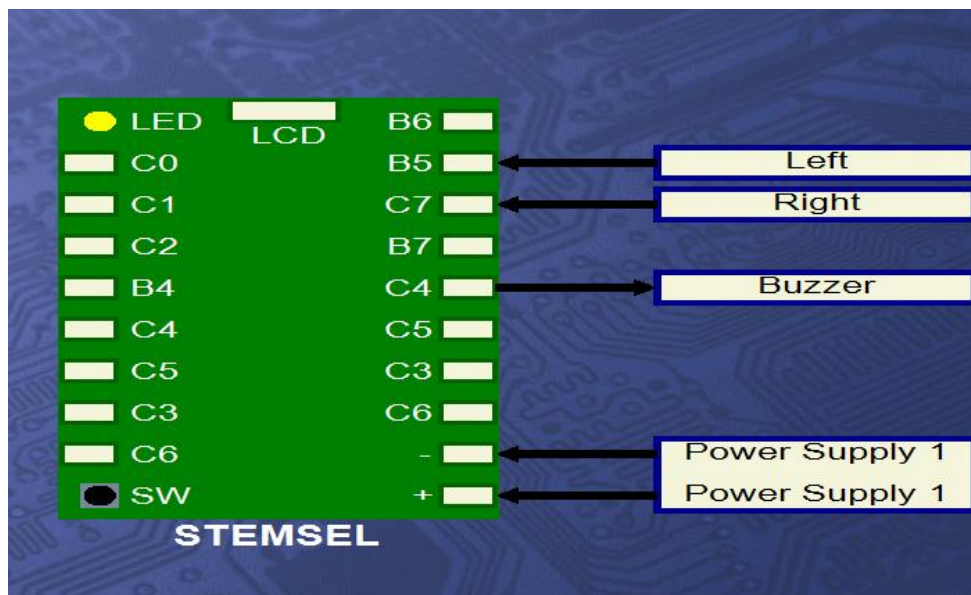


Figure 3: STEMSEL controller board Circuit

## Build the circuit

Now we need to connect the components to the STEMSEL controller board with the LDRs and Buzzer. All the white wires to the ports specified in the design, black wires to negative (-) port and red wires to positive (+) port. You will also need to use sticky tape to hold the LDRs at an angle of 90 degrees.

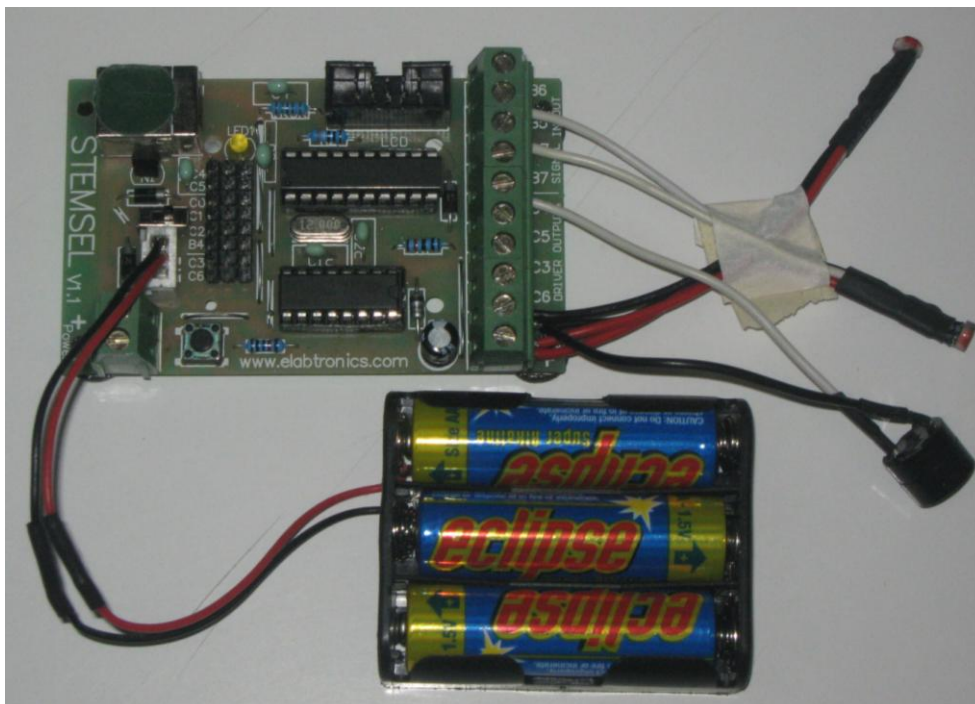


Figure 4: circuit

## Programming

Once you have assembled the circuit, send the design to CoreChart by clicking the “Send to CoreChart” button. After verifying the circuit by sending the test program to the chip, delete the test routines so we can start writing our program.

1. The first step is to read the voltage from the LDRs using the *Analog\_in* icon from the *Input* button, Double click the *Analog\_in* icon to edit the properties from input pin select *Left* and rename save as to *LeftVolts*. Repeat the step once more and *Right* pin and save as *RightVolts*.
2. According to our plan, we should now compare the values from the LDRs, and if Left is greater than Right we will turn the buzzer on. Click on *Numbers* then *Compare*, and use it to compare *LeftVolts* and *RightVolts*.
3. Use *OnOffPin* icons to add the buzzer according to the conditions mentioned above.
4. Finally, add a *GoTo* icon at the end of the program so that it repeats. Your program should look like the following:

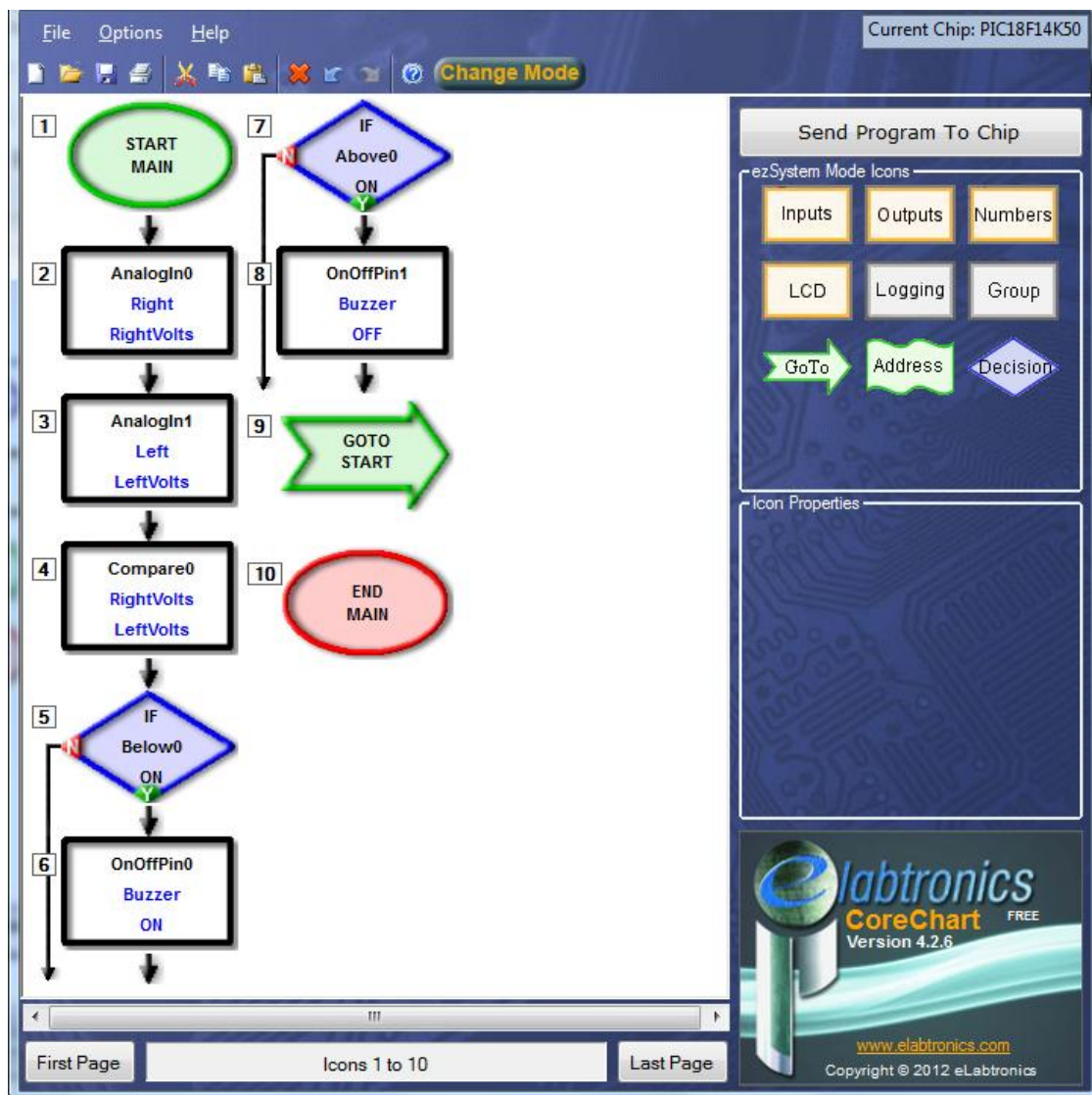


Figure 5: Program in CoreChart

5. Now send the program to the chip and test your device. Ensure the LDRs are at a 90 degree angle. If one LDR is more sensitive than the other, it may be necessary to put heat shrink or similar tubular object on the more sensitive one so that less light falls on it; remember the buzzer should switch from on to off or vice versa when our device is pointed directly at the light source.

### **Activity**

Clear a space in front of a table and set up a lamp so that it shines across a darkened room. One by one blindfold each student and see if they can use their device to find the lamp.

### **Summary**

Our eyes are very useful in helping us live our everyday lives, so if they stop working it can be very difficult to do even simple things. For this reason people have invented many devices to assist blind people. In this project we made such a device that would help blind people find which way the light was coming from by using two LDRs to detect the light they can't see. It is important to help people with a disability so that we can all live happy lives.