STEMSEL LCD Project 7 : LCD Bar Graph

Problem

We are aiming to display the value of the POT as a bar on the LCD. In order to achieve this, we need to have a string 'current level' on the top line and an integer, 'X', on the bottom line.

Background

It is often useful to look at large volumes of information and see if patterns emerge, this is called statistics. However, our human brains are not very good at interpreting large amounts of numbers, which can make it difficult to notice trends. This is why it is often useful to display this information on a graph, as this makes it much easier to see certain information.

There are many different types of graph, such as bar graphs, pie charts, histograms, scatter plots to name a few. Statistical analysis is often used in scientific research, for example to compare the effectiveness of different medical treatments; plant or bacterial growth rates under varying conditions, quality control, traffic on a road or on a webpage, etc. In all of these examples, graphing the results can make them much clearer. There are even several examples of where graphing information has led to important societal change. Way back in 1854 before people knew about germs, John Snow was able to plot cases of cholera in order to trace an outbreak of the disease in London back to its source at a contaminated water pump. At about the same time, Florence Nightingale used a modified pie chart to highlight the military command that most of the British casualties in the Crimean War were dying of infection in the field hospitals, not of their wounds on the battlefield, eventually leading to improved sanitation in the camps.

In this project, we will display a bar graph across the LCD screen in order to show different information.

Ideas

How could we display a bar on our LCD? How can we change the size of the bar? What kind of information could we display?

Plan

In the project, we need to use a POT to change the voltage level, which will be displayed by printing a series of 'X's on the LCD. Since a maximum of 16 characters can be displayed on the LCD at once, our bar will range from 0-16 characters long.
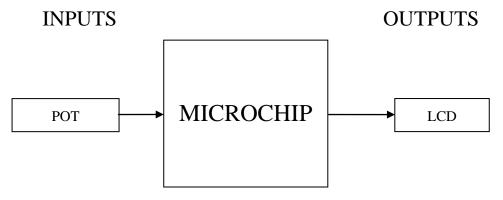
INPUTS   OUTPUTS

Figure 1: Inputs and Outputs

Design
Begin a new STEMSEL project in ezCircuit and add a LCD and a potentiometer to the circuit board and name it "Dial". Note that the components should be inserted into the slots which appear as light green.

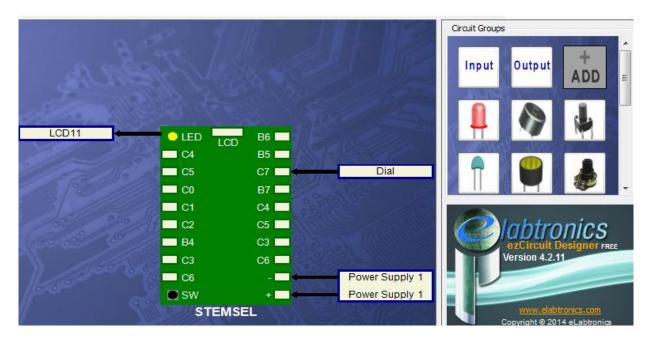The completed design should appear as shown below.

Figure 2: Circuit Design

Build

Insert the white signal wire, red and black wires of the POT into C7, positive (+) and negative (-) slots respectively. Then plug the LCD into the LCD port on the top of the STEMSEL controller board. The complete circuit should appear as below.
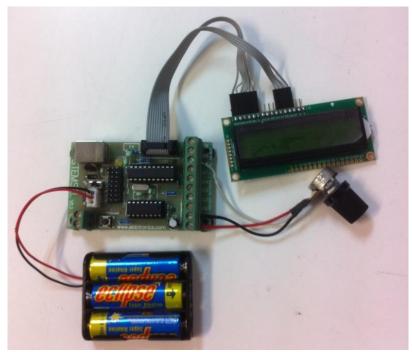

Figure 3: Circuit

Programming

With the design and assembly completed, send the design to CoreChart to program the microchip. Before starting to program, all outputs of the circuit and the components should be tested using the testing program generated. Make sure the button is pushed and the onboard switch is off when connecting the STEMSEL controller board to your computer.

1. Our first step will be to add a half second time delay, and then clear the LCD with 50 hundredth of a second delay using an LCDFormat icon ready for subsequent loops. This will ensure the display does not flicker.

2. Read the value of the dial using an Analog_In icon, saving it as "Level".

3. Our Level variable will range from 0 to 255. Since we only have 16 levels, use a "Divide icon" to divide Level by 15. This will ensure our Level variable is between 0 and 16.

4. We will use a decrementing loop in order to display the correct number of 'X's on the LCD. Use an address called Display_Loop to set the start of this decrementing loop.

5. Use a Compare icon to see if Level is equal to 0. If so, then no more 'X's need to be printed and we can go back to START in order to read the Level in again.

6. If the Level is above 0, we need to print more 'X's. Use an LCDMessage icon to display an 'X' on the LCD.

7. We have now displayed one 'X'. Use a Subtract icon to take one away from our Level variable, saving the result back as Level.

8. Finally, add a GoTo icon to go back to the Display_Loop address in order to check if we have now displayed all the required 'X's.
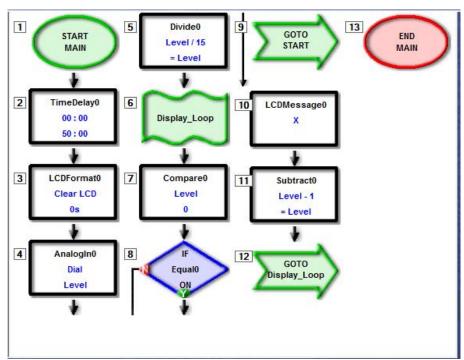
9. Send to chip and test your program.

Figure 4: Program code

Our graph presently doesn't show what kind of information it is displaying, which doesn't make it terribly useful. Is a high level good or bad? We will now improve our program by giving an indication of what we are displaying.

1. For this tutorial, we will be displaying fire danger. After we get the level but before the Display_Loop address, use LCDMessage to print "Fire Danger".

2. We will add some levels to display as well. Low will be below 5, med is from 5-10, and anything above 11 is high. Add a Compare icon after the previous LCDMessage icon and use it to check if level is below 6.

3. If it is below 6, use another LCDMessage to display "Low".

4. Use a CompareBetween icon to check is Level is between 6 and 10, and if it is between, display "Med" with a LCDMessage icon.

5. Use another Compare to display "High" on the LCD if level is above 10.

6. This message leaves us with no room on the first line on the LCD to display our bar graph. Move the bar to the second line using an LCDFormat icon just before the Display_loop address.
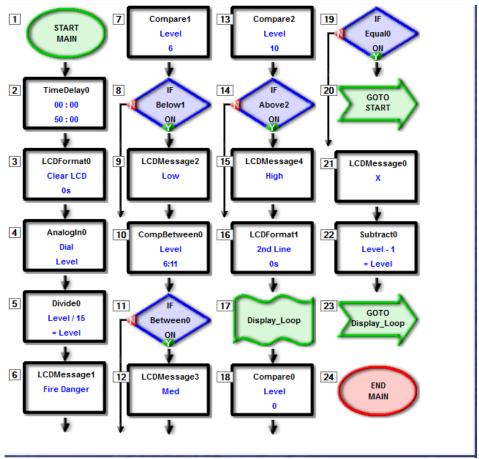
7. Send the improved program to the microchip and test it.

1 START MAIN
2 TimeDelay0 / 00:00 / 50:00
3 LCDFormat0 / Clear LCD / 0s
4 AnalogIn0 / Dial / Level
5 Divide0 / Level / 15 / = Level
6 LCDMessage1 / Fire Danger

7 Compare1 / Level / 6
8 IF Below1 ON
9 LCDMessage2 / Low
10 CompBetween0 / Level / 6:11
11 IF Between0 ON
12 LCDMessage3 / Med

13 Compare2 / Level / 10
14 IF Above2 ON
15 LCDMessage4 / High
16 LCDFormat1 / 2nd Line / 0s
17 Display_Loop
18 Compare0 / Level / 0

19 IF Equal0 ON
20 GOTO START
21 LCDMessage0 / X
22 Subtract0 / Level - 1 / = Level
23 GOTO Display_Loop
24 END MAIN

Figure 5: Improved program

Extension

See if you can improve the display even further. You could add more levels to the fire danger indicator, experiment with printing different characters other than X, or come up with your own information to display.

Summary

Whether it's testing the effectiveness of a new medical treatment, or testing if plants grow better if they listen to classical music or heavy metal, statistics allows people to search for patterns and reach correct conclusions. Graphical methods of displaying information can make it much easier to see patterns and trends compared to just looking at the numbers alone. However, linking all this information together is very difficult, and needs many scientists and engineers to dedicate their knowledge over several years. Do you want to be one of them, helping human beings live a better life and discovering the truth of the universe?