

## STEMSEL LCD Project 10 : Microwave

### Problem

How can we use a microchip to control a microwave? How can we use a LCD to show the countdown?

### Background

Microwave ovens pass microwave radiation into food in order to heat the food up. Microwaves, the greatest of all the electromagnetic waves, cause the water molecules in the food to vibrate. This vibration produces friction which creates heat, which is then passed into the food. The diagrams below show what a water molecule is composed of.

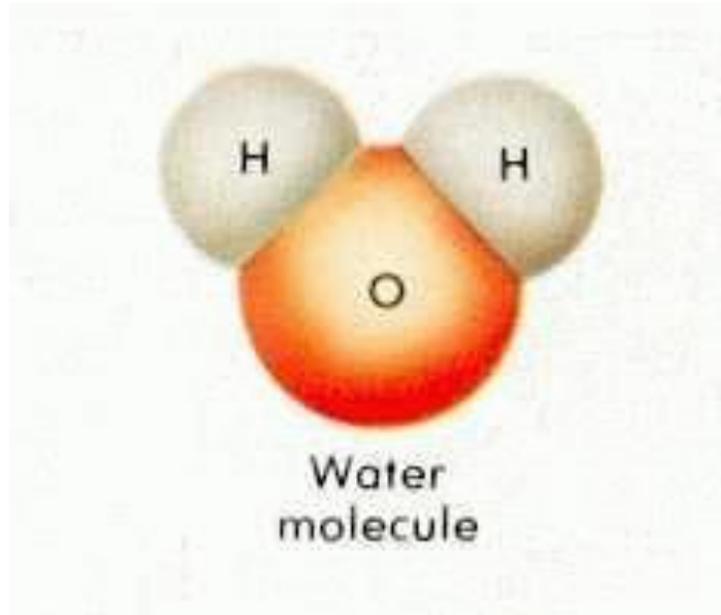


Figure 1: Water Molecule

From the diagram, it can be seen that the water molecule consists of two hydrogen atoms and one oxygen atom in a very unbalanced way, which means that they can be easily stimulated by certain electromagnetic waves, e.g. microwaves.

In this project, we are aiming at using a LCD to perform the countdown for a microwave. A motor is used to show that the microwave is heating up the food and a buzzer is added to indicate that the countdown has finished and the food is heated.

### Ideas

How can we set up the heating time? When should the buzzer be turned on? How can we indicate that the microwave is working and when should the microwave be turned on?

### Plan

A POT will be used to set up the heating up time, which will be displayed on a LCD. A buzzer will be used to indicate that the countdown is finished and the food is cooked. A motor should be added as well to show that the microwave is turned on. The diagram below shows the classifications of the components.

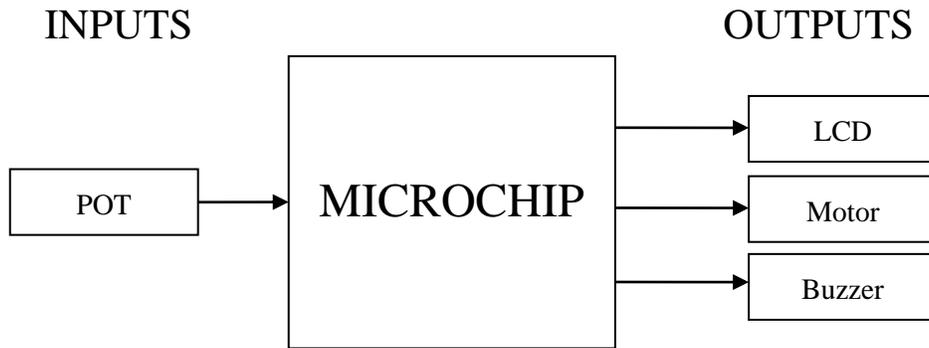


Figure 2: Inputs and Outputs

### Design

Firstly, open the ezCircuit Designer and begin a new STEMSEL project and then add a motor, a POT, a buzzer and a LCD on the STEMSEL controller board. Make sure you insert the components to the right slots as shown in the circuit design below. All the components can be found in the circuit group.

The completed design should appear as shown below:

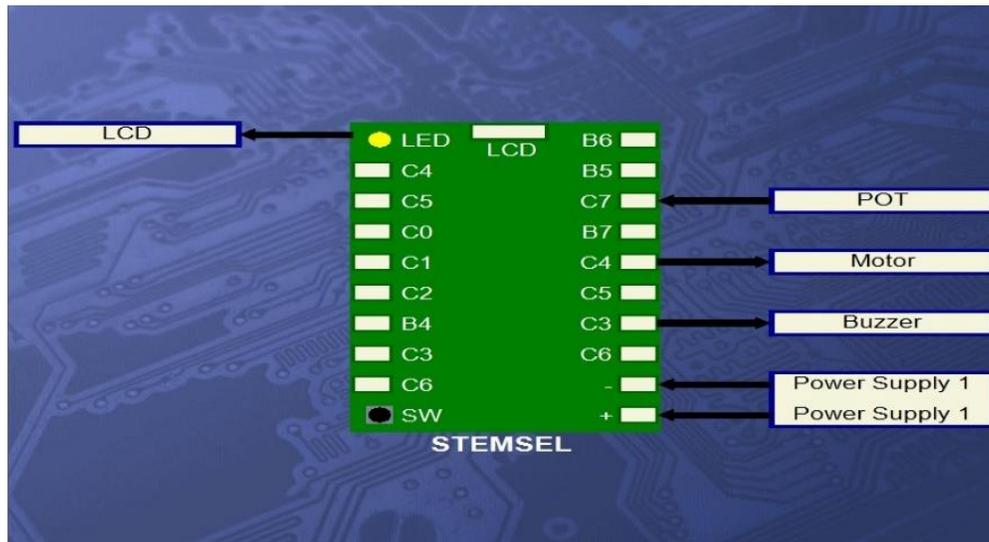
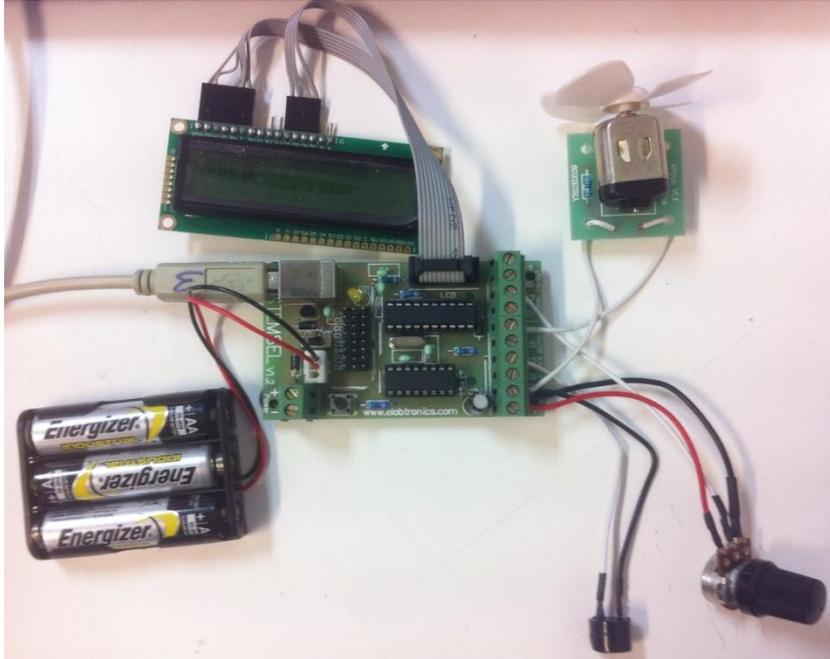


Figure 3: Circuit Design

## **Build the Circuit**

Now the circuit can be built following the design above. Make sure the white wires of the POT, motor, and the buzzer are inserted into ports C7, C4 and C3 respectively. The black wires of the POT and the buzzer and one of the white wires from the motor should all be inserted into the negative (-) port. Finally, the LCD should be plugged into the LCD connection port on the top of the STEMSEL controller board.



**Figure 4: Circuit**

## **Programming**

With the design and assembly completed, send the design to CoreChart to program the microchip. Make sure the button is held down whilst connecting the STEMSEL controller board to your computer. Before starting to program, ensure that the in/outputs and the components are working using a testing program.

1. Start by clearing the screen of the LCD. Insert an "LCDFormat" after the "START MAIN", select "Clear LCD" with "No Delay".
2. Insert an "AnalogIn" after the "LCDFormat", which will take values from the POT and call it "Time". Then add a "DispNumberLCD" right after the "AnalogIn" to display the time. Add a 0.2s "TimeDelay" after it to keep the message on the screen. Add a "GOTO START" at the end to create a loop.
3. Insert a "Decision" after the "TimeDelay" and customise "A3\_PushButton" to Off. Then a countdown system will be generated which can be activated when pressing the on-board button.
4. Insert "Address" after the diamond shaped "Decision" icon and call it "Loop". Then add an "OnOffPin" to turn the motor on and then put an "LCDFormat" to clear the message with "No Delay".

5. Group up the icons containing “Loop”, “Motor” and “Clear LCD” into a group named “Count\_Down”
6. Inside the group called “Count\_Down” add a countdown timer and then displayed by adding a “DispNumberLCD” after the previous message is cleared. Double click on the icon and select “Time” in the drop down menu. Set a 1s “TimeDelay” as an actual timer.
7. Subtract the value of “Time” by 1 to perform the counting down procedure. Compare the “Time” with 0 to check whether the countdown is complete. If the “Time” is greater than 0, add a “GOTO” to the “Loop” which was created before to create a loop for “Time”>0. Turn off the motor to indicate that the microwave has finished heating up the food.
8. The final step is to turn on the buzzer for a reasonable time period to notify the user that the food is heated up. Make sure that the program returns to the start at the end.

The complete program appears below Figure 5, double check if it is the same with yours. The details of the group are shown below in Figure 6. Note that there is not enough power to activate both the LCD display and the motor at the same time therefore it is recommended that the USB is connected to the computer.

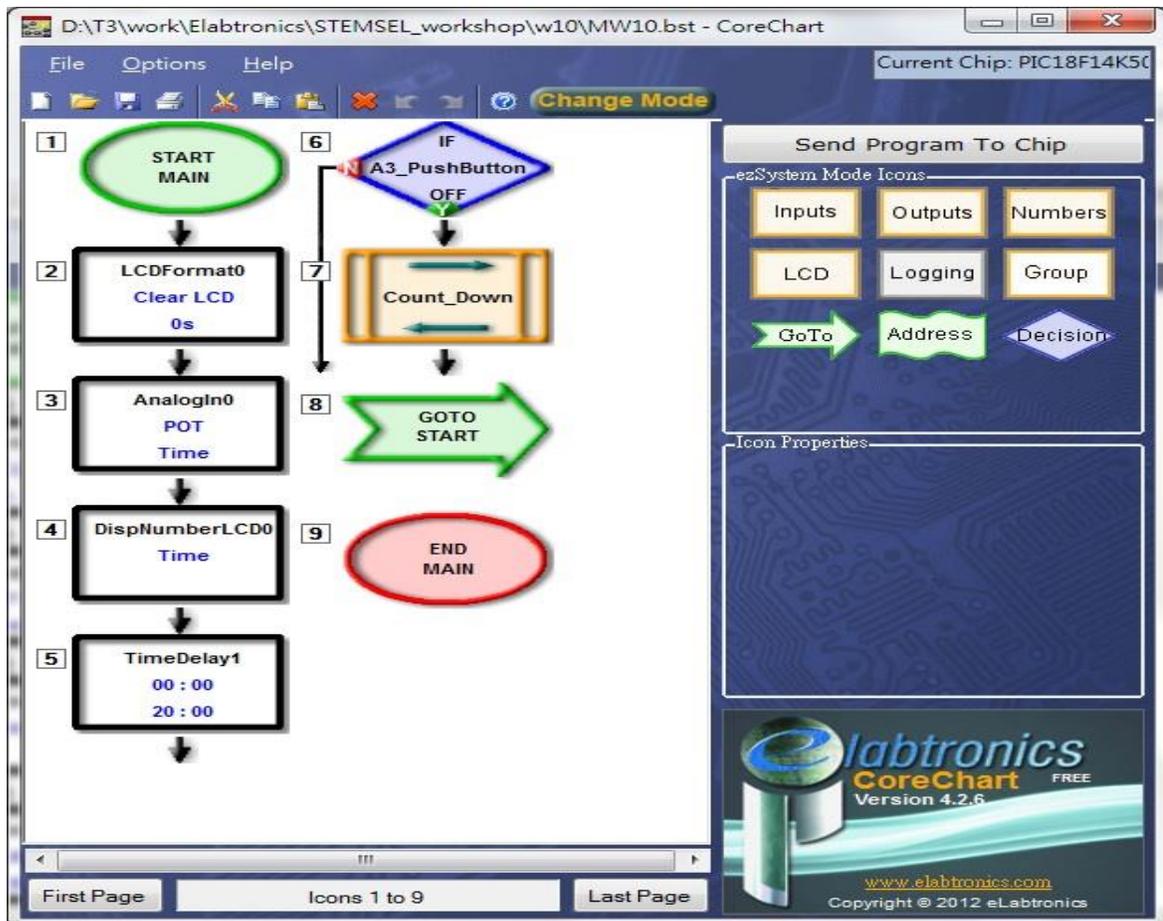


Figure 5: Completed Program

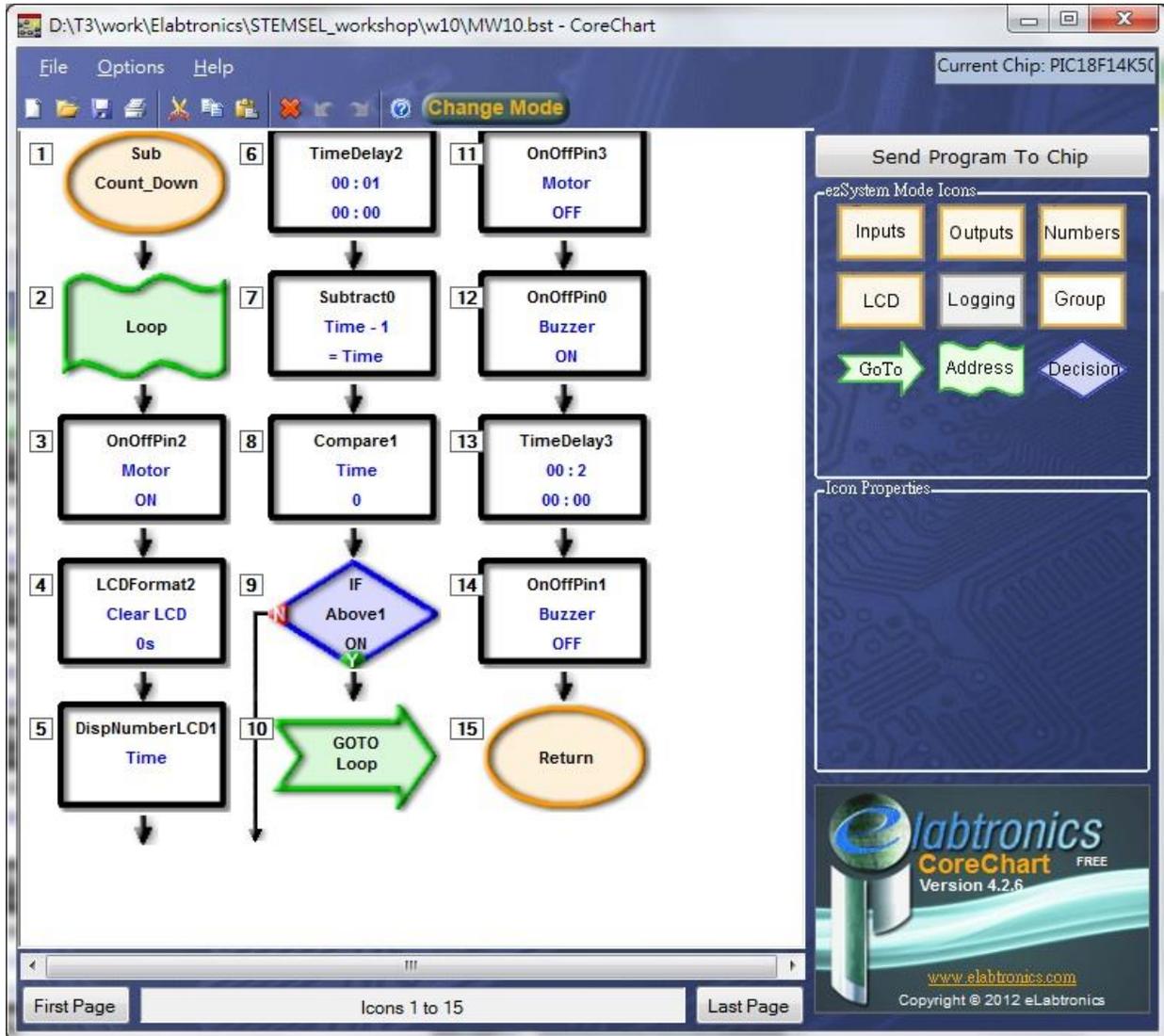


Figure 6: "Count\_Down"

### Extension

How can we display the message "enjoy your meal" on the LCD when the countdown is complete? How can we make the motor turn in one direction for the 1<sup>st</sup> half of heating, and then turn back the other way for the second half? What is the benefit of this?

### Summary

Through this project we learnt how a microwave works by simulating the countdown procedure using the STEMSEL controller board. We also learnt how to perform a countdown using a LCD and how to use a potentiometer to control the input.