Laboratory Report 8 Digital Systems

Module	EE4522. Digital Systems 1
Date	15/04/2023
Lab Number	8
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Introduction:

In this lab we were presented with a reverse-engineering challenge and a new component was to be used which is the piezo-electric sounder. Piezoelectricity is also a new concept we had to work with. Which is the reversible process of electrical charge separation due to mechanical stress. We needed to make the buzzer sound in a certain frequency and then measure and record the data we collected using the oscilloscope.

Procedure:

We will be required to use the following equipment:

- Breadboard
- Piezo-electric sounder
- Wires
- LED
- 74HC193 chip
- 74HC14 chip
- Capacitors (10uF and 100nF)
- 330Ω, 10kΩ and 100Ω resistors

Using the truth table, schematic of the adder and a wiring diagram it was possible to construct the circuit which should look like figure 1 when finished.

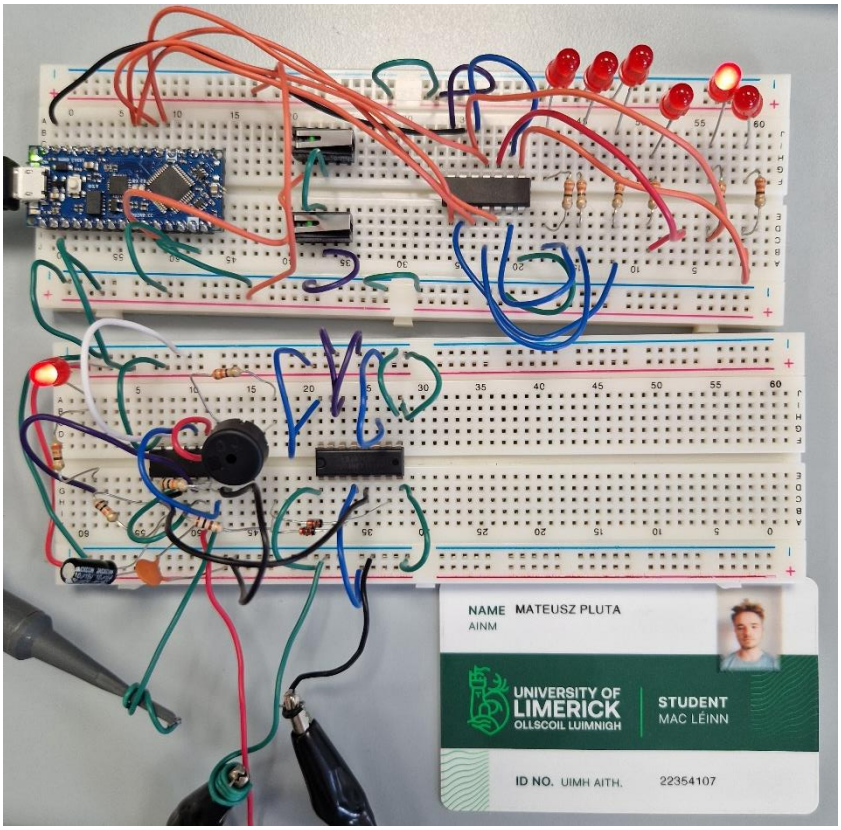

Figure 1 Photo of the circuit.

Results:

Challenge 8.1

The most basic explanation of what the circuit does is just basically causes the piezo-electric sounder to buzz a certain frequency, however for that to happen there are many steps that must be met.

Firstly, there are two relaxation oscillators found in the circuit which generates a periodic waveform such as a square wave or a triangle wave depending on what its set to. There are two capacitors. In the smaller capacitor(100nF) oscillator it takes less time for the capacitor to charge therefore there are more waves sent, however in the second oscillator there is a bigger capacitor (1uF) which takes longer to charge therefore bigger waves but in smaller frequencies. These oscillators are responsible for making the sound in the buzzer.

Secondly, there are multiple inverters found through out the circuit (Figure 2).

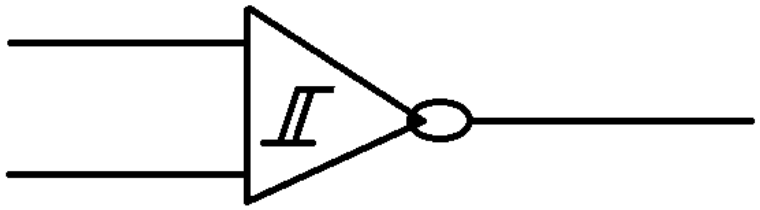

Figure 2 Inverter diagram

The inverters are responsible for changing around the binary code from 0 to 1 or 1 to 0. Which also are a part of the buzzer sounding the way it does.

The resistors do not allow as much current to go past them as there are multiple sources of 5V going into the circuit therefore the chips may overheat. I have encountered this as I had a problem with my circuit, and it began to heat up. So, making sure the correct resistors are put in place to not destroy the LED, buzzer or the chips is important.

The LED allows us to see whether we have short-circuited the circuit and that is it working, there is a resistor beside it to make sure that it doesn't burn off the LED.

Lastly, the two diodes allow the current to flow in one direction while blocking current flow in the opposite direction. These are responsible for the little gaps in the buzzing sound as when I remove 1 diode the gap become smaller and if I remove both there are no gaps between the sounds, and it becomes a constant buzzing sound.

Challenge 8.2

Removing both diodes causes the piezo-electric sounder to create a constant sound with no gaps in between.

Challenge 8.3

When D2 diode is taken out constant beeping is produced, when D2 diode is in then it has bigger rests between beeps. When it is connected to QC there are smaller rests.

Challenge 8.4

I set the scope to 10x probe, and I have measured multiple locations on the circuit to get these results as shown in figure 3. As we can see the measurements are on the top left corner of the picture.

Figure 3 Photo of the scope

Conclusion:

In conclusion I was able to complete the reverse-engineering challenge and successfully build the circuit with the piezo-electric sounder. I was able to understand the process of the circuit as well what happens if I change or remove certain components from the circuit. Lastly I was also able to measure and record the data from the oscilloscope.

Declaration of authorship: “I confirm that this lab report, submitted for assessment, is my own original work”.