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Electrical Engineering 221 Lab

Section 1001

December 8, 2017

Final Project

Metal Detector

Goal:

The goal of our final project was to create a circuit that would have good potential applications. The circuit that we aimed to design and implement was a circuit that could detect metal that would come within a close proximity of it.

Roles:

The final project consisted of many tasks that needed to be planned with care in order to finalize everything before the deadline. The roles were split evenly among the members of the team which consisted of two people. Each team member had specific important roles that needed to be completed in order to have a successful project.

Ricky Perez:

Ricky Perez had one of the first important roles when it came to choosing what our final project would be about. After hours of initial research, he narrowed down our circuit options to three circuits. After discussing it with Daniel, it was decided that they would go with the metal detector circuit. Ricky was assigned the role of demonstrating the circuit we had decided on, to the TA, in order to get approval for it. After getting approval the team was able to continue on with the project. Ricky also assisted in preparing the presentation, mainly by providing appropriate images to make the PowerPoint visually appealing.

Daniel Senda:

Once the circuit design of the metal detector was approved by the TA, Daniel had the important role of performing more in-depth research on the metal detector circuit to have a solid understanding on how it was going to piece together. In addition, Daniel created the schematic

of the circuit in LTSpice. He also gathered the components needed in order to start building the circuit. Once the component situation got figured out, he had the task of building the circuit on a breadboard using the acquired components and wiring. Daniel was also assigned the task of creating the lab report for the circuit. In addition, he also helped prepare for the presentation.

Overall, both team members contributed hours of hard work in order to get the final project finished and polished up in time for the presentation.

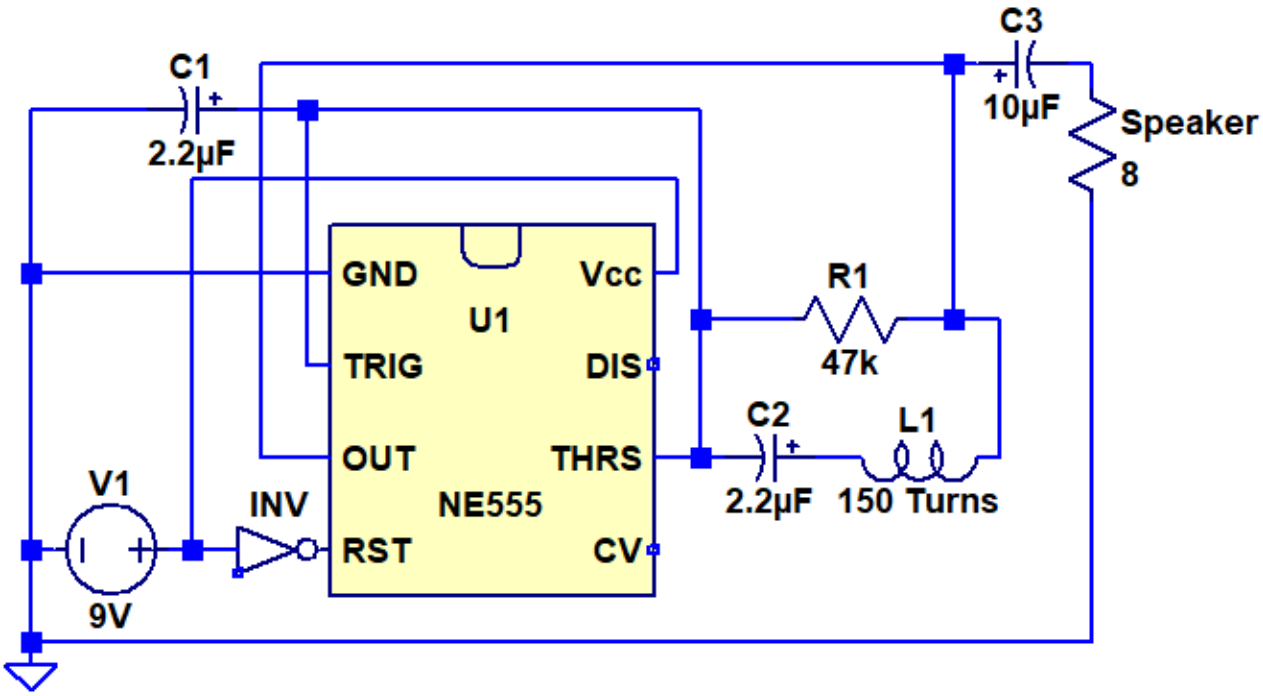
Background Theory:

The metal detector first emerged in the late 1800s. During the time, many inventors/scientists were experimenting with new knowledge that was emerging relating to electricity. One of the first recorded metal detectors was invented by a Parisian man who created a metal detecting device used to locate bullets in human patients. The following paragraph is going to describe the theory behind the metal detector.

Essentially, a metal detector consists of some type of LRC circuit. First, let us discuss the operation of an inductor. An inductor is a coated coil of wire that generates an electromagnetic field when there is current going through it. In the metal detector circuit, the inductor is connected to a capacitor and resistor to form an LRC circuit. When an alternating source with a constant frequency is connected, it creates a certain impedance depending on the electrical values of the components in the circuit. When the circuit stabilizes, the impedance stays at a constant value. Now we can begin to explain the circuit we created with greater detail in the circuit operation section of this lab report.

Schematic:

Before creating the schematic for our circuit, we had to decide what program we were going to use. The options that we had was either Quartus or LTSpice. Daniel was more familiar with LTSpice, so it was decided to go with that route. The following picture is a screenshot of the metal detector circuit designed in LTSpice.



Circuit operation:

In the circuit, we have a constant 9V voltage source that powers the circuit. The voltage is connected to a 555 timer which creates a square wave with a constant frequency. The square wave is then connected to an LRC circuit. The constant frequency of the wave creates a stable impedance among the LRC components. The wave and impedance work together to create an audible frequency which can be outputted through a speaker that is also implemented in the circuit. This overall sums up the composition of the metal detector circuit created. When the

circuit is operating at its stable state, the inductor is generating an electromagnetic field. This is where the metal detecting comes into play. Whenever a piece of metal comes within a close proximity of the circuit, the electromagnetic field is altered. The alteration creates a change in current, which in return changes the impedance of the circuit. The change in impedance can be audibly noted through the changing sound that the speaker is outputting. The result is a circuit that can notify a user when there is a metal object near the electromagnetic field of the inductor. Thus, we have a metal detecting circuit.

Conclusion:

Overall, we successfully reached our goal and created a circuit that has good potential applications for the real world. The metal detector circuit is already used for different kinds of things. One example of an important use for a metal detector is for airport security. In the process of creating the circuit, both team members learned more in depth about the operation of LRC circuits. It was a very educational experience to build the circuit and learn the theoretical side of the circuit. There were some problems along the way but the team was able to address the issues and continued forward. In conclusion, the team created a functioning metal detector circuit successfully and gained valuable experience along the way.