ECE 1000 Final Report: Guitar Fuzz Pedal

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***Abstract* – The Guitar Fuzz Pedal outlined in this report showcases the culmination of both of our knowledge gained from this course. The project aims to distort the frequency provided by an electric guitar, essentially converting the wave from a standard sine to a square wave. Using several components soldered onto a PCB, the wave that goes into the circuit is passed through several types of intricately designed filters to accurately and efficiently distort it. The operator of the fuzz pedal can freely adjust the volume and effectiveness of the pedal through two potentiometers. The usefulness of the fuzz pedal created in the late 1960's changed the way musicians would create and use electric signals as sound. This report includes the design, functionality, and its impact on the music industry as a whole.**

I. INTRODUCTION

The project was mainly inspired by the work of Jimi Hendrix and his use of various pedals. One of the most notable pedals he used was the fuzz pedal, which distorted the frequency that was inputted from the electric guitar. We delved into researching and the design of the fuzz pedal that Hendrix used. After researching we discovered how DC and AC currents were combined and how to design the circuitry of our own fuzz pedal.

II. BACKGROUND

In developing our fuzz pedal, the "FuzzBuddy", we did extensive research on how to combine AC and DC currents, and what role the transistor plays in it. We used YouTube for tutorials for circuitry design in the combination of AC and DC circuitry and how to design a PCB using the Circuit Maker software. The references section below acknowledges these sources for proper credit.

III. PROJECT DESCRIPTION AND FORMULATION

Materials:

1. 15k Resistor
2. 2k Resistor
3. 2 4k Resistors
4. 2 AC128 Germanium Transistors
5. 10.0uF Capacitor
6. 2.0uF Capacitor
7. 0.1uF Capacitor
8. 50k Potentiometer
9. 500k potentiometer
10. 2 1/4 inch input audio jacks
11. 9 Volt source
12. Electric guitar

Diagram:

Figure 1 shows the reference schematic of the fuzz pedal we decided to use along with the schematic we ended up using, with a few notable differences between the two.

Figure 1: Reference schematic of Fuzz Pedal

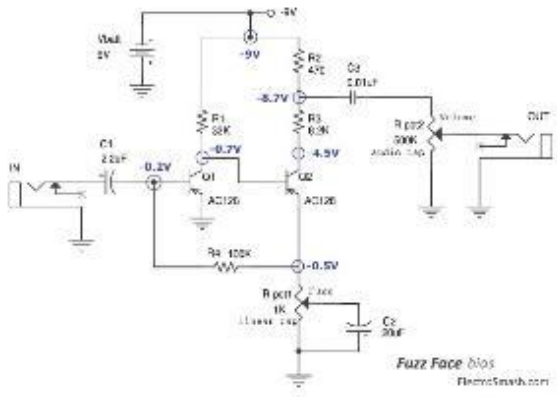
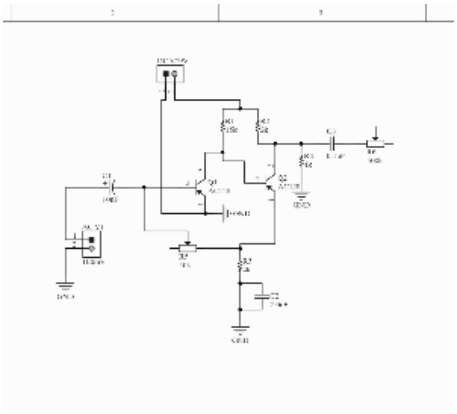


Figure 2: Schematic used for actual project



The following images show the PCB and 3d models we planned on incorporating into the full design. However, due to time constraints these were not able to be fully implemented, but the concepts of these are still included to show the full design process.

Figure 3: 3D model of Fuzz Pedal body

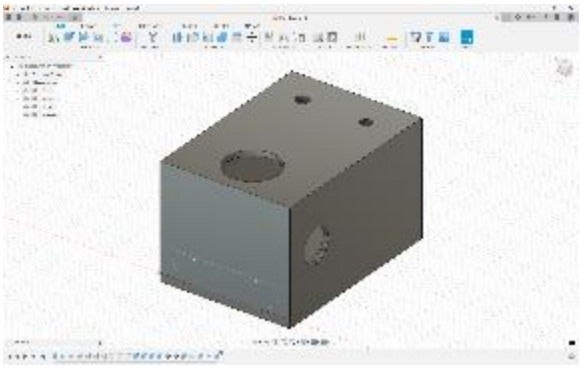
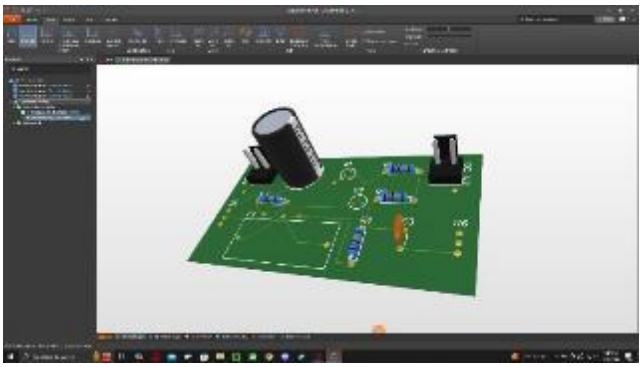


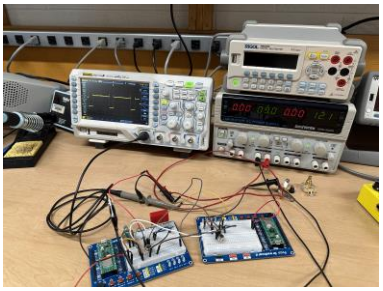
Figure 4: 3d representation of PCB



Full System:

As mentioned previously, time did not permit us to have every aspect of the design done, such as the PCB and 3d model. What we have is a working prototype on two breadboards that is pictured below.

Figure 5: Prototype of Fuzz Pedal



Functionality:

The overall purpose of the circuit is to transform a sin wave, produced by the guitar, into a square wave. This square wave, when put through a guitar amplifier and speaker, provides a sound that can be noisy, muffled, and distorted.

This type of sound has allowed musicians to create new and more interesting pieces of music. The guitar signal passes through a capacitor at the very beginning of the circuit, this capacitor is not particularly meant for the AC current, but rather, is meant for the DC current. The capacitor stops the DC current from entering through the capacitor while allowing AC current, from the guitar, to pass.

The purpose of the transistors in the middle of the circuit is to amplify and cut the signal of the

guitar to create the square wave. The transistors serve the most crucial role in the circuit, as they are the component that alters the sin wave from the guitar. One thing that can be surprising to notice is the material of the transistors does matter. The transistors used are AC128 PNP germanium transistors. Germanium can provide a more earthy and warmer sound compared to the silicon transistors that are used in modern guitar pedals.

The large capacitor, shown in figure 5, is the capacitor that is used in the feedback loop of the circuit. This portion of the circuit is used in parallel with the transistors to help induce a cutting on the sin wave, without this portion of the circuit, the wave does not transform into a square wave. The potentiometer in this part of the circuit is what controls the degree of which the wave is cut.

Lastly, the capacitor at the very end of the circuit is used with the combination of the resistor beforehand, and acts as a filter between AC and DC current. This filter allows only AC current to leave the pedal and travel to the guitar amp.

IV. DISCUSSION AND RESULTS

Our recreation of the fuzz pedal proved to be somewhat successful, with the audio coming out perfectly as intended, however the visual representation of the wave was an issue to say the least. When we tested the prototype using a waveform generator to simulate a consistent wave outputted from the guitar, the results were exactly what we expected. Once we attached the guitar to the input instead of the waveform generator, the output was nothing like what we expected.

The wave seemed to have a very large amount of noise accompanying it, which was most likely due to the guitar itself making residual noise from after it was strummed, or the components within causing some sort of disturbance. We still decided to call the project a success since it produced the correct sound audibly, it just could not be tracked using an oscilloscope.

In an attempt to rectify the error, we tried using different size cords or different input jacks into the circuit. These yielded somewhat hopeful results, as playing around with the inputs enough led to the oscilloscope output being less noisy. However, there was simply too much noise to get rid of that we still did not fully know the cause of. We decided to stop messing with the input and go off the results found when using the waveform generator.

Overall, we were able to successfully accomplish our objective to recreate the Fuzz Pedal, but there definitely could have been some adjustments and improvements that could have yielded a much better result on the oscilloscope.

V. CONCLUSION

The Fuzz Pedal is one of the pedals that showed a turning point in the electric era of guitars. Jimi Hendrix was one of the great musicians that showed the potential of utilizing pedals like this one to enhance a musical experience.

During the creation of our version of the Fuzz Pedal, we realized the significance of tools like these and how much music has evolved from over a millennia ago.

As with any project, there were some notable flaws with our design that most come down to time constraint, such as a lack of a frame and proper PCB to set all the components. With enough time, these issues could be resolved and would result in a much cleaner finish and hopefully a more successful result on the oscilloscope.

REFERENCES

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