A ‘Sound’ Project

So how do speakers work?

Shalom Israel Kommu

7th Grade

East Valley Christian School

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Part One: The Speaker Kit

In this part of my report, You will read about the speaker kit which I first built. This kit allowed me to see what was in a speaker, but I didn't yet understand how it worked. This section consists of some research on how speakers work as well as the building of the speaker kit.

Abstract

It’s 2022!!!

Masking is almost over, and life is somewhat returning back to normal.

Which made me think on what to do this year for the science fair. I was in silence, save for the fish tank in the background, filtering and letting out its water. As I listened to the tank, I thought about how sound works.

What worship experience is complete without sound? Sound is one of those things we take for granted. In previous projects, specifically my animation and my video-game project, I remember noting down that things feel dead without sound. Sure enough, as I am typing out this report, I can’t imagine my keyboard not clicking along and still feeling that my keyboard is, well, a piece of real hardware.

So how do we hear sound at church? How is sound converted to binary, and back to sound again? What do our speakers do to recreate a very unique sound? This year, I will make a speaker, and find out just how a speaker works.

Problem and Hypothesis

Problem: How does a speaker work?

Hypothesis: A speaker works by vibrations which are created by magnetism.

Materials

To make a speaker, I need:

- Magnets
- Wire
- Paper
- Scissors
- A hot-glue gun
- A phone or other device to play music to the speaker

Challenges

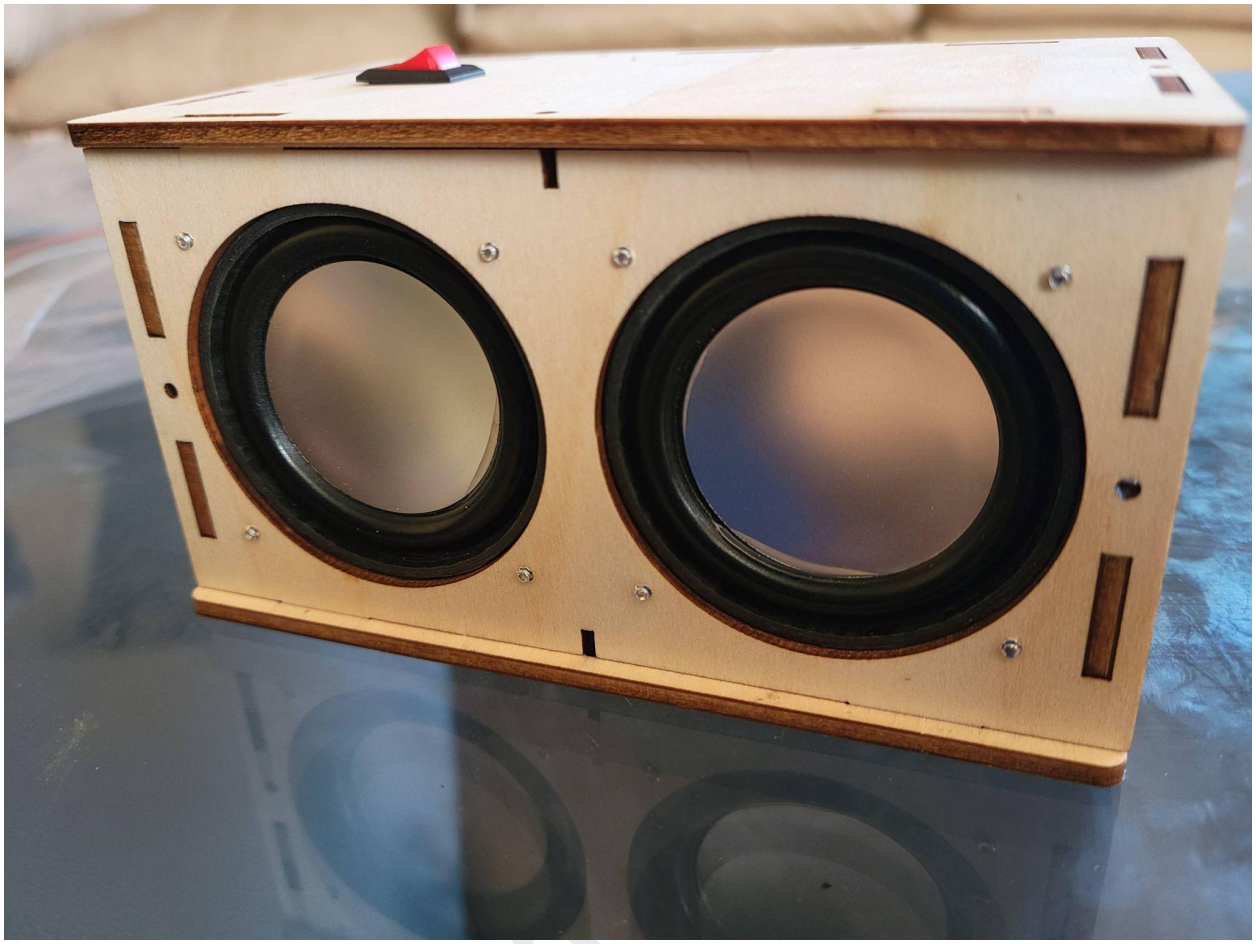
There were many challenges that I came across while making my speaker. Some of them had to do with the process itself! I have listed the more generic challenges.

- Cost
    - I am only in eighth grade… and as such, I have a tight budget to work with!
- Building Materials
    - As I said, I am in eighth grade, and unfortunately, because of that, I cannot use a material like plastic to make the speaker!

The Speaker Kit

The speaker kit was mainly a help for me to know how a speaker works. In the speaker kit, I noticed that the speaker had a large magnet. This proved my theory of magnetism.

The speaker also confused me, because it came with bluetooth, and I thought that the bluetooth chip did more than just bluetooth. At this time, I needed to do more research before I could clearly understand how a speaker worked. The speaker kit helped me to see the text in practice.

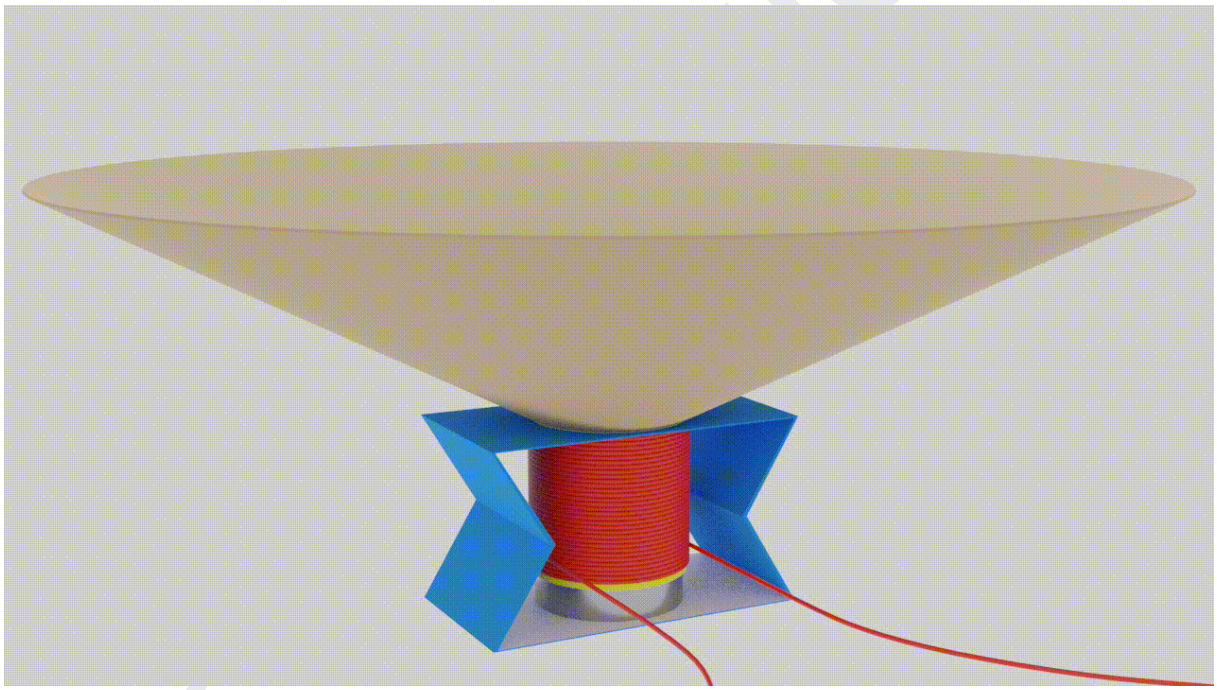


Research: Sound Waves

Sound is simply another form of energy - an energy created by a vibration. It cannot travel through a vacuum, and it is a longitudinal wave. With that being said, how does a speaker create sound?

Research: Speakers

Speakers create sound by having the front part, known as the cone or diaphragm, vibrate. The cone vibrates due to magnetism. A permanent magnet is placed behind or under an electrical coil. This coil, when charged, becomes another magnet, and is pushed away from the permanent magnet. This coil is connected to the cone, and as it becomes a magnet and back again, the cone vibrates, creating sound. Now that I know how a speaker works, I can create a speaker, and see what factors make speakers louder and quieter.



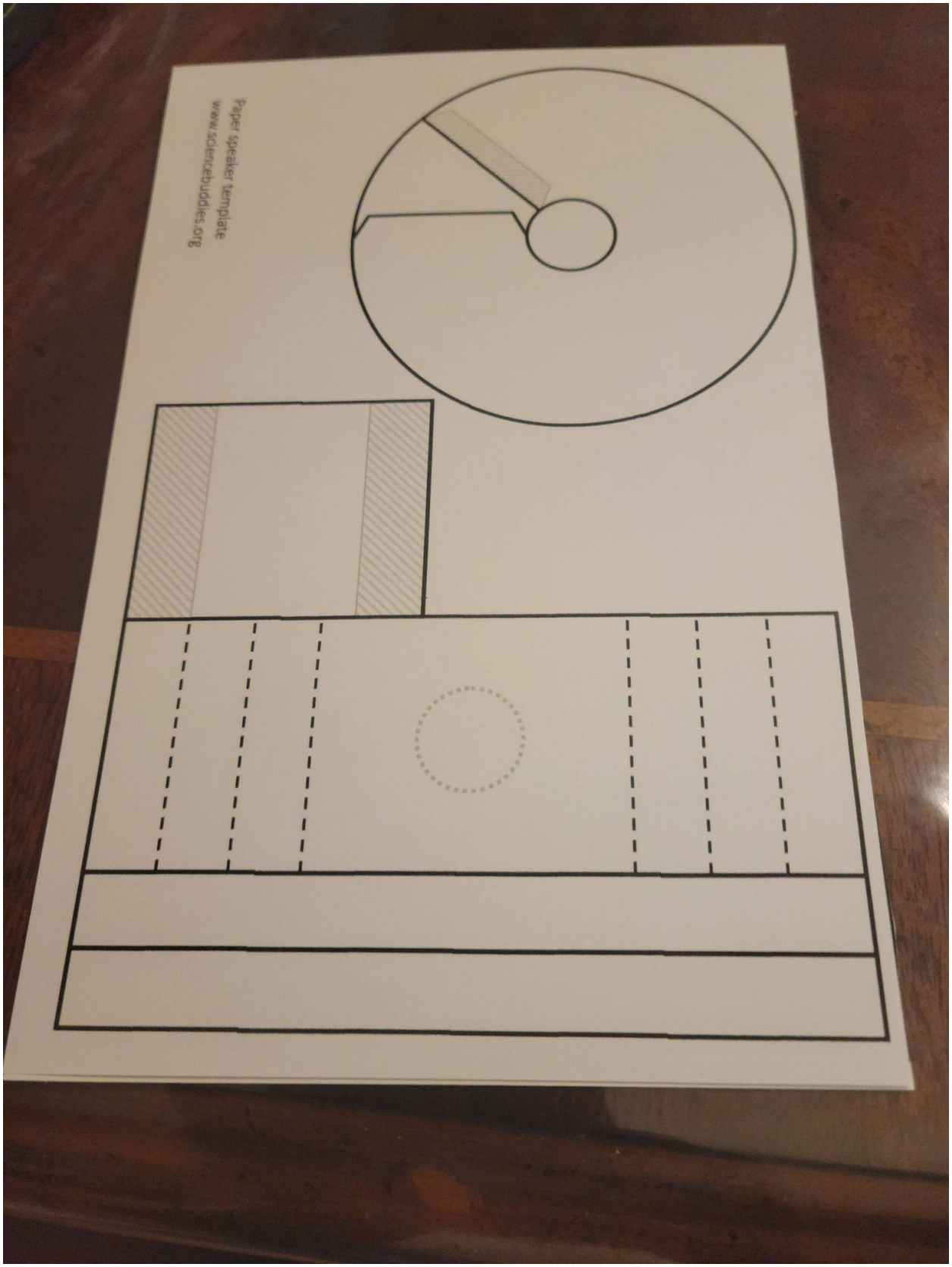
Part 2: The Paper Speaker Template

In this section, I made a speaker using a paper template.

The Paper Print-outs

At this point, I was unsure on how to create a speaker. I knew the parts, and where they went, but I did not know how to assemble one, or even create the parts. That is when I started using a paper template.

The paper template had the parts of the speaker, and it was up to the user to assemble it. The difference between this and the speaker kit is that in the speaker kit, the speaker is assembled, you just have to connect it to bluetooth. In this part, I had to make the coils that become a magnet.


Paper speaker template
www.sciencebuddies.org

The First Paper Speaker

The paper speaker had 50 coils. It was very quiet, and I needed to put my ear to it to hear it. Before I do anything to experiment in making the sound louder, I had to test on different materials.

Part 3: The Cardstock Speakers

In this section, you will read about how I made more speakers out of cardstock. This was to find out exactly how much the amount of coils made a difference to the overall speaker.

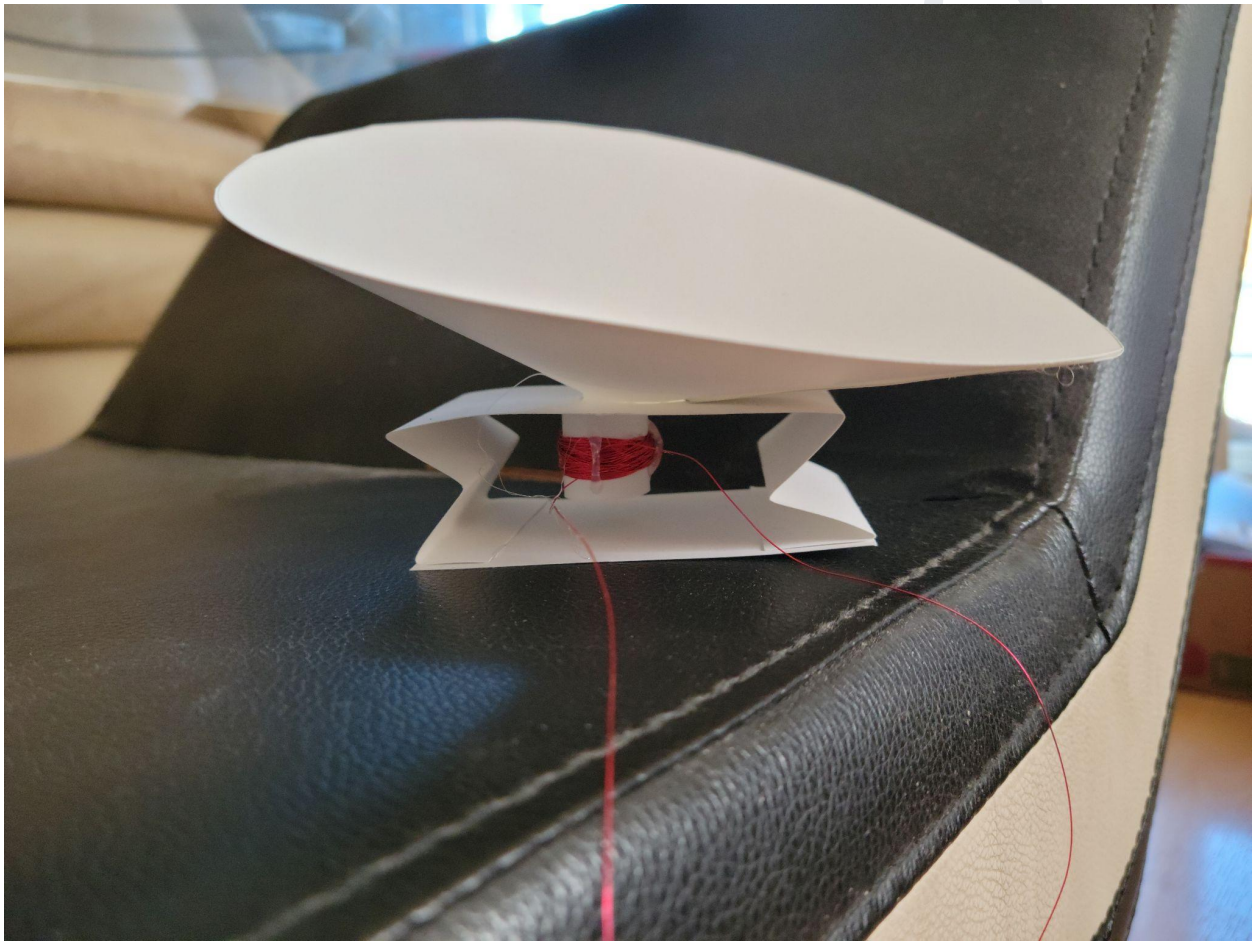
A quick note…

I spent the most time on this part of the project. Coiling the wire around a paper cylinder is surprisingly hard! The key is patience, as I learnt.

The Speakers

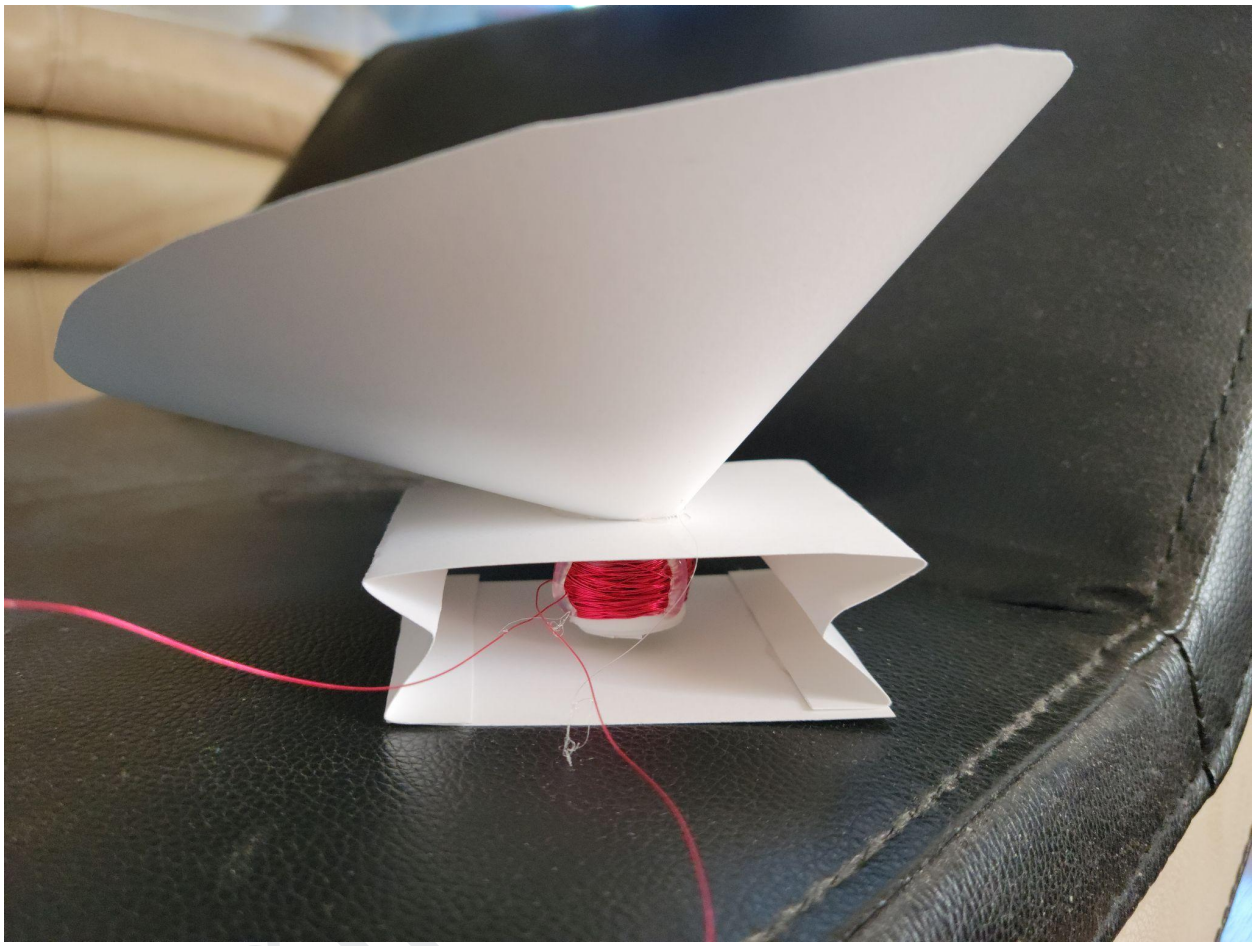
The 50 coil speaker

The 50 coil speaker was quite easy. I had done it before, and I could go quite fast while fixing up the 50 coils.



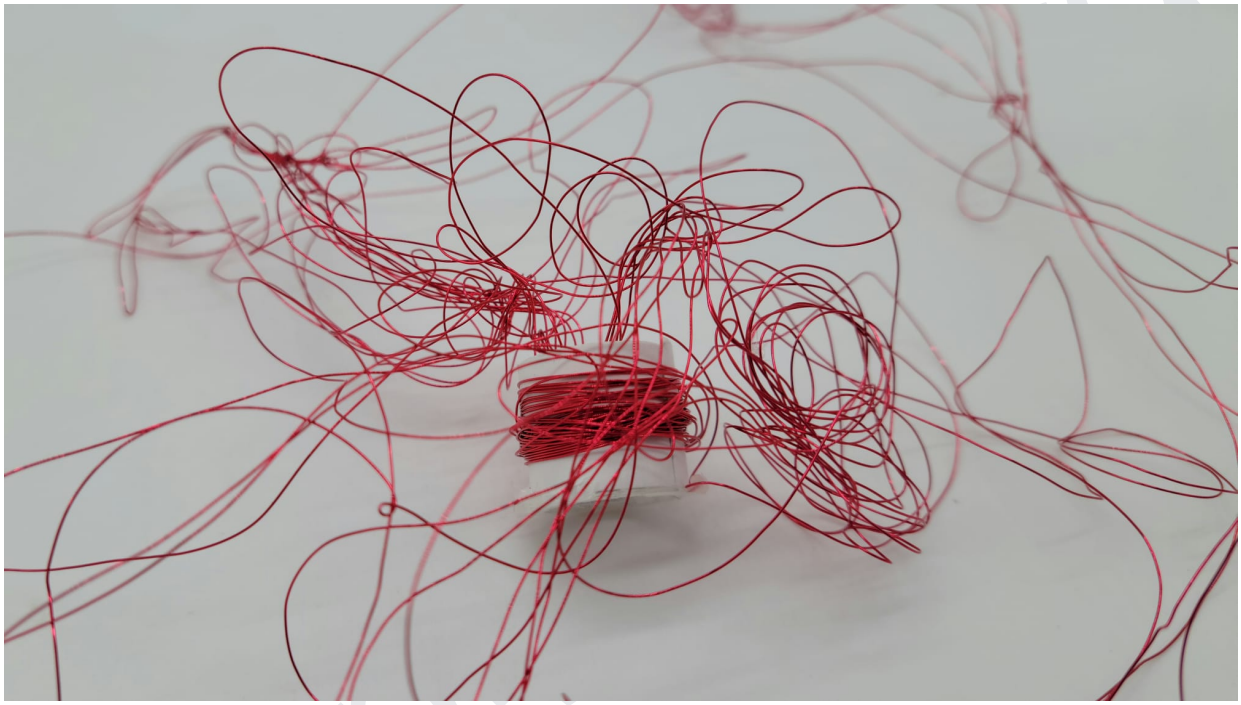
The 100 coil speaker

Coiling a wire 100 times was again quite simple. Only once I went too fast, and that caused about 3 coils to come off. Nothing too serious.



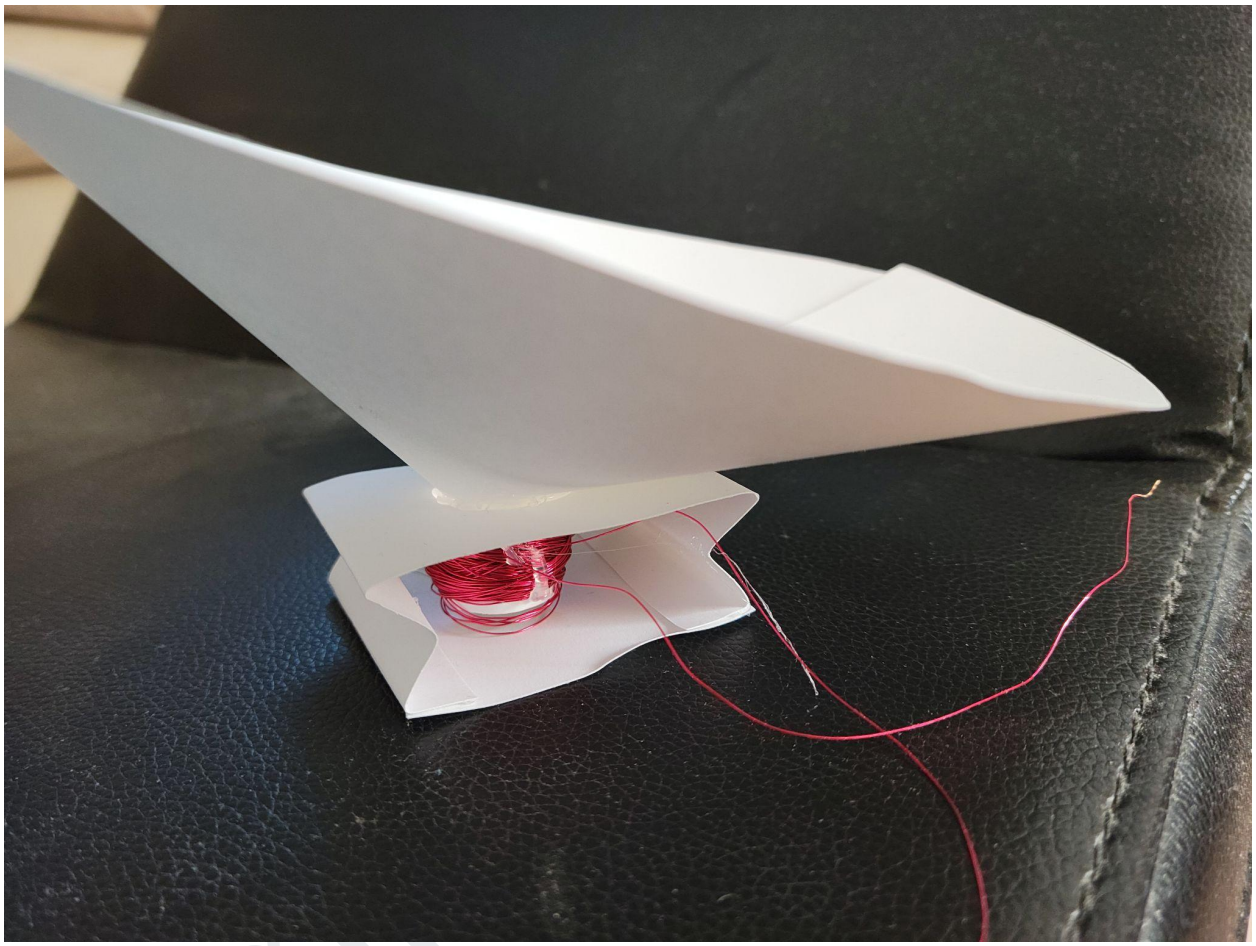
The 150 coil speaker - Trial One

This was incredibly saddening. I got to 138 coils when what looked like 30 coils came out. And it wasn't done there! As I tried putting the coils back on, even more coils came off. I immediately got to work on a second 150 coil cylinder.



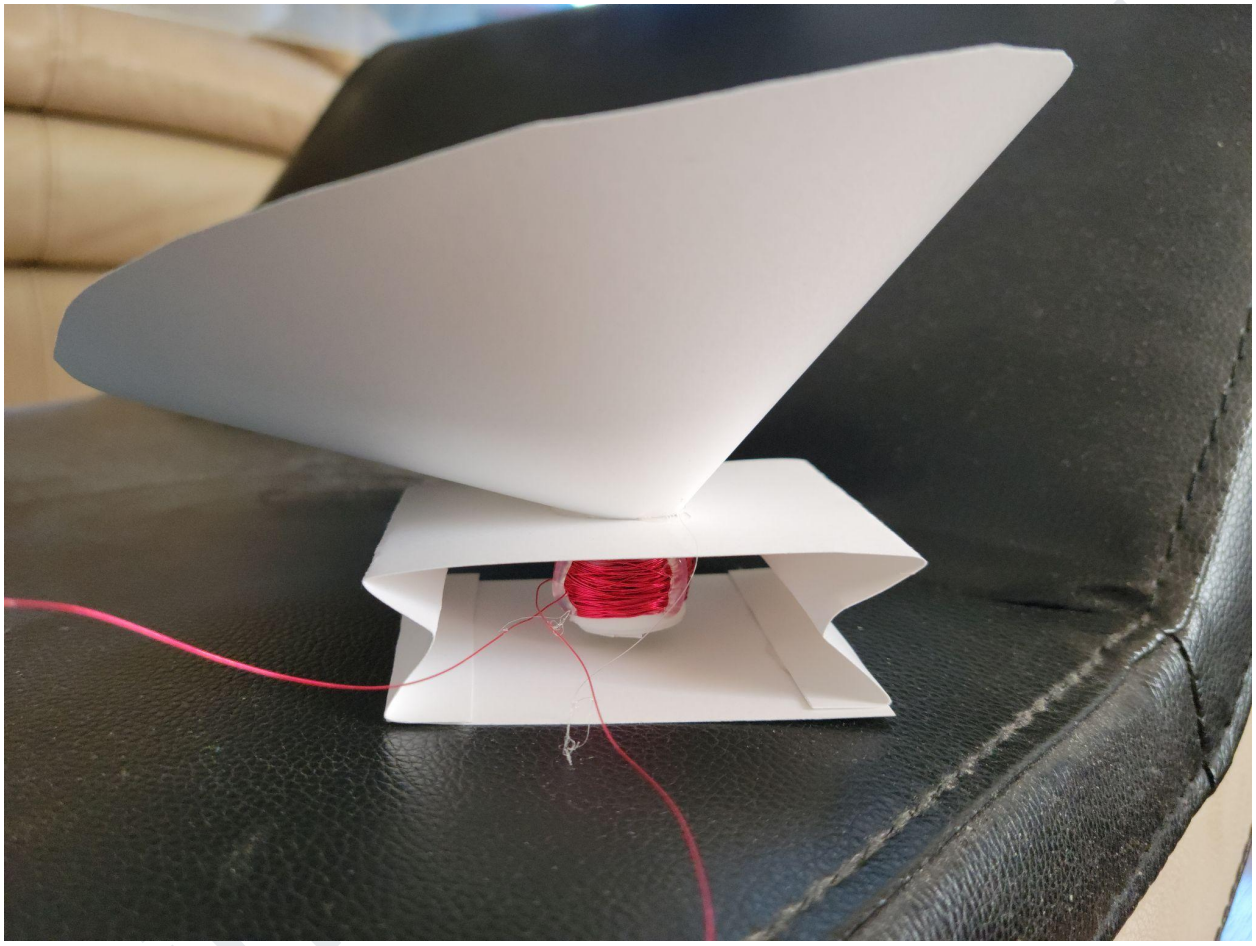
The 150 coil speaker - Trial Two

Thankfully, though my first attempt failed, I was able to successfully coil the wire around the paper cylinder!



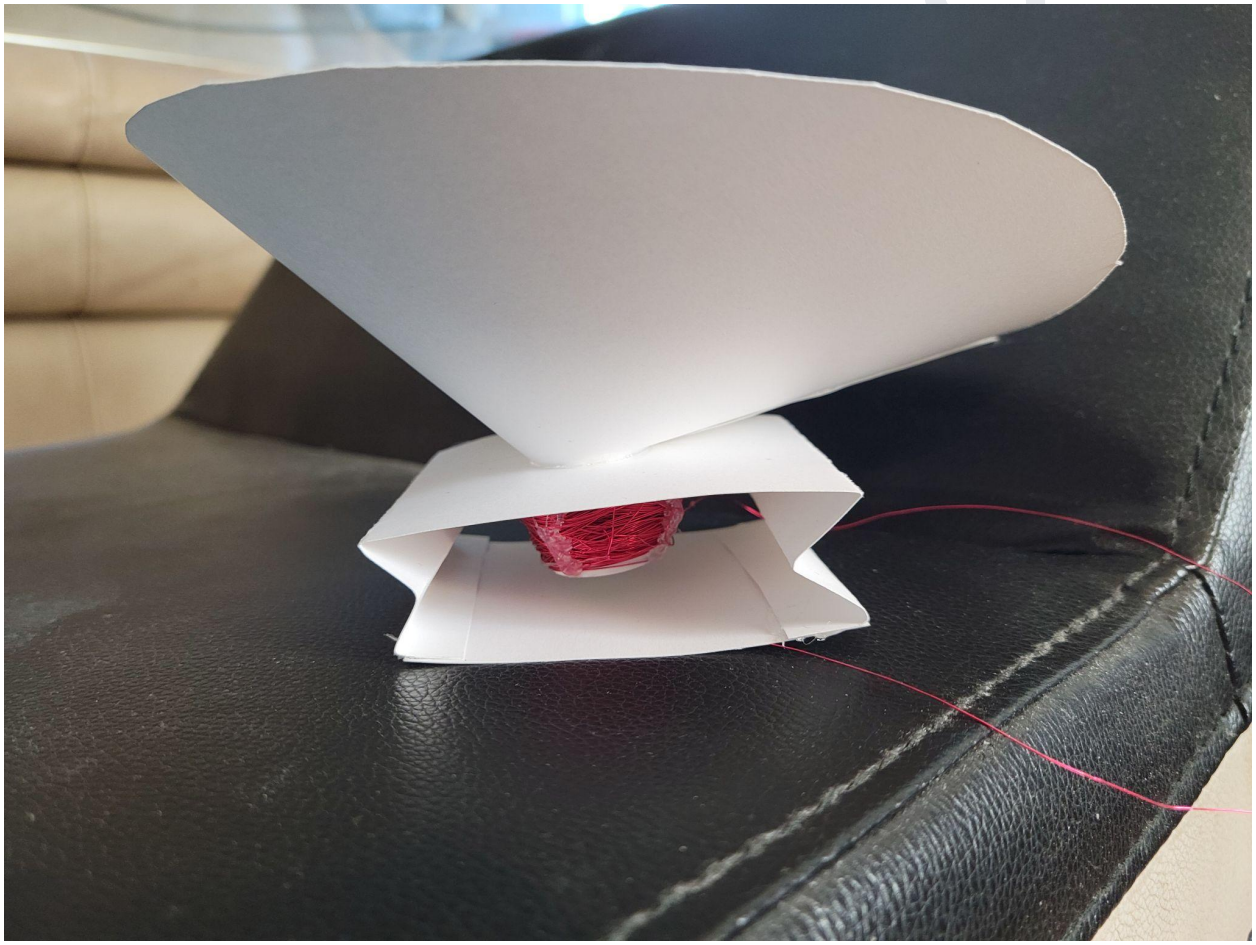
The 200 coil speaker

I did this right after my 150 coil speaker worked. By this time, I had gotten into the groove for making the coils. Though it did get hard around the 180 coil mark, this was, for the most part, smooth sailing.



The 250 coil speaker

This was hard. I spent around 15 minutes coiling the wire around the paper cylinder. As I said, once you get to around 120, things start to get quite difficult. The main problem is that once you go to 120, the wire will not simply stay in the middle of the paper cylinder. It wants to go to the sides. Thankfully, I was able to coil the wire around the paper cylinder without another failure.



It may not look big in the picture, but this coil is massive!

Results

Pre Results Notes…

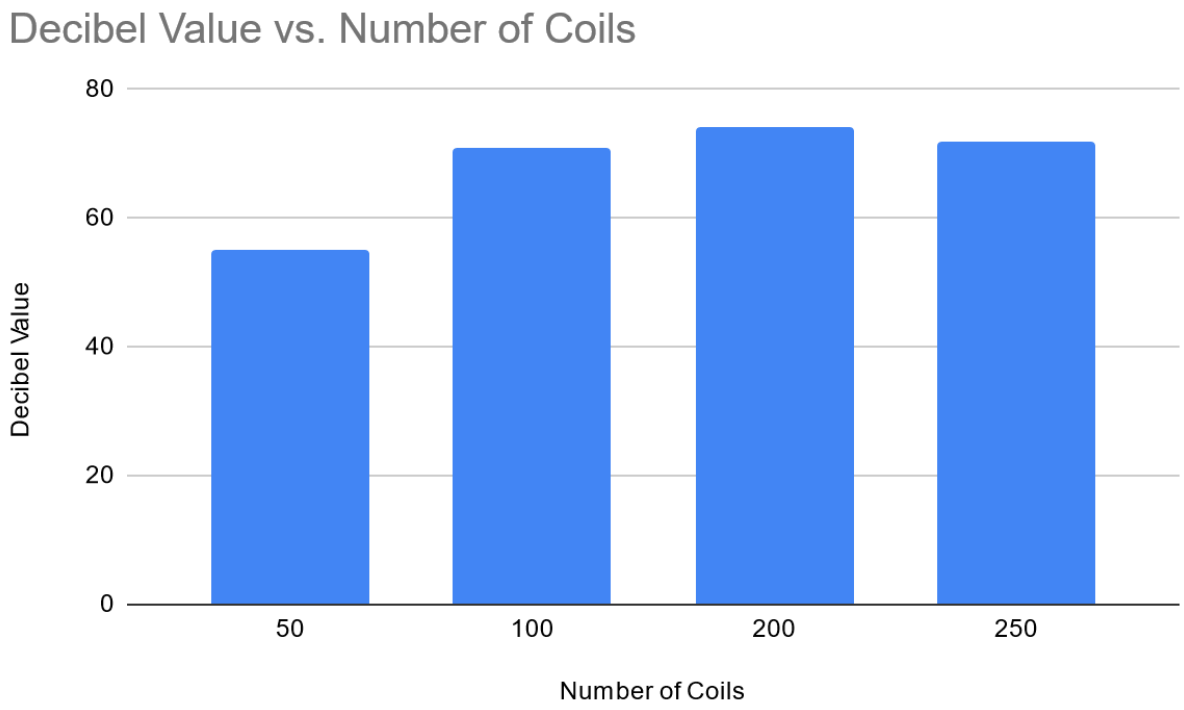
Unfortunately, it turns out that my 150 coil speaker was faulty. The paper loop was too tight, and as such, the magnet was stuck. Because of this, there is no chart with a 150 coil speaker.

Also, to test the sound, we used the song “How Great Thou Art” sung by Chris Rice. In this song, we used the second “soul” in the second chorus.

Finally, we found the decibel measurement called “Sound Meter” on my phone.

Number of Coils

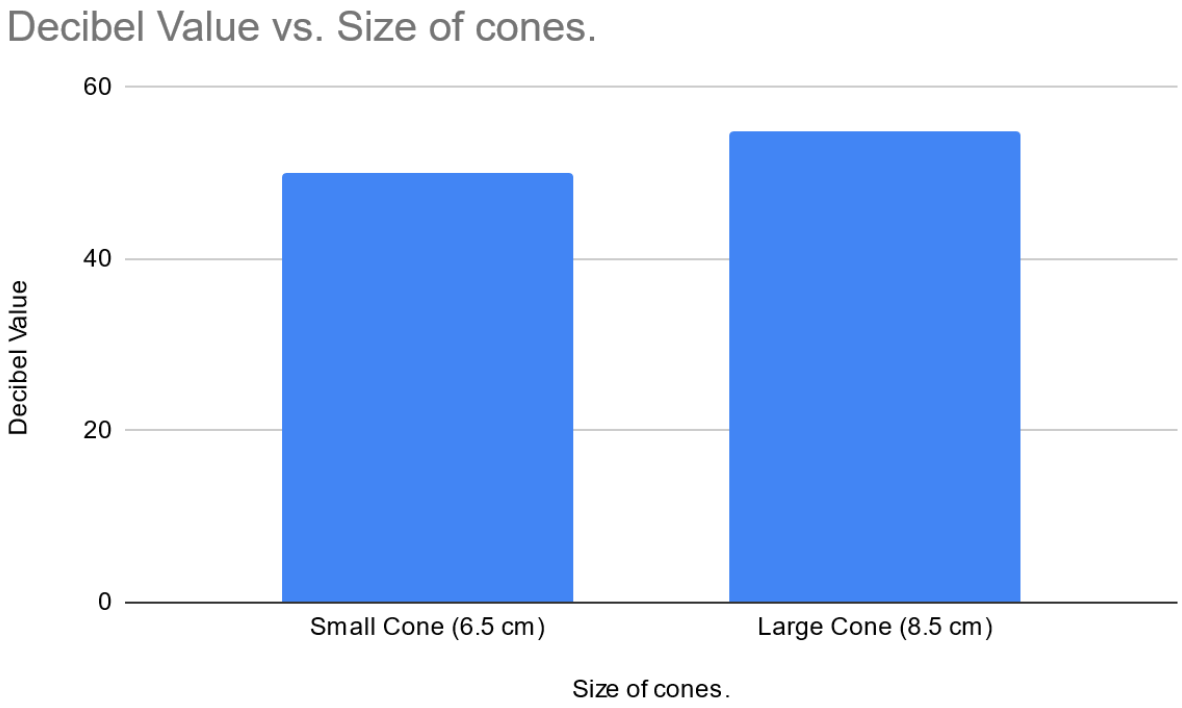
The number of coils on a speaker affected the overall volume by a lot. Though the decibel values may look close together, there was a great difference between the two sounds.



As you can see, the more coils, the more sound. This, however, wasn't the case with the 250 coil, which is probably because 250 coils was too heavy for the speaker.

Size of Cone

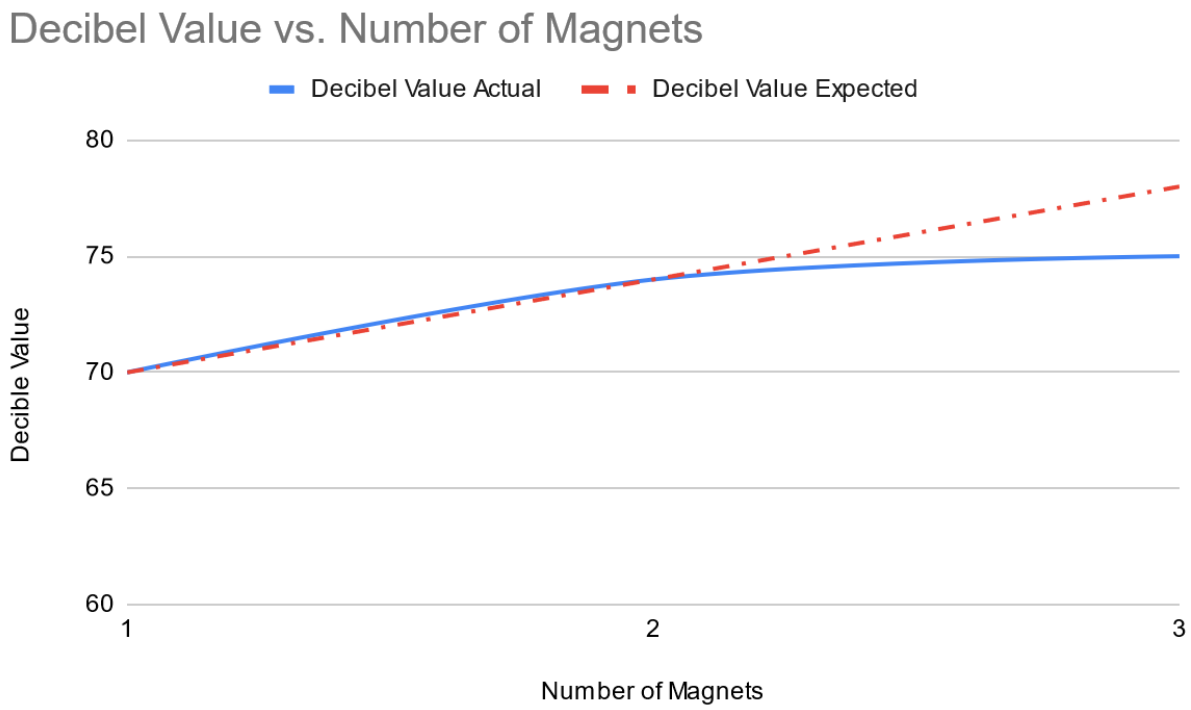
I decided to see how the size of the speaker cone affected the 50 coil speaker. I made another 50 coil speaker with a small cone.



As you can see, the larger cone had a louder sound.

Amount of Magnets

As you have seen, the 200 coil speaker is the loudest of all the other coil amounts. Because of this, I wanted to find out how much of a part magnets played in the sound of a speaker.



This time, the more magnets, the louder. However, after two magnets, the amount of a sound difference becomes insignificant. Also, I had to hold up the paper when I put in three magnets, because the magnets were taller than the speaker! All in all, A cardstock speaker with approximately 200 coils and 2 magnets will give the best amount of sound. Paper simply cannot bear more!

Part 4: Wrapping things up

Biblical Worldview, Hard Lessons, Acknowledgements, and Bibliography is found in this section.

Biblical Worldview

Romans 10:17

“So then faith comes by hearing, and hearing by the word of God”

One of the ways that people are saved is because of hearing the word of God at a church, where, in most cases, the pastor is being heard through speakers! Speakers can broadcast the Word of God.

Luke 19:40

“But He answered and said to them, ‘I tell you that if these should keep silent, the stones would immediately cry out.’”

As we have learned, sound is caused by vibrations. We also know that it was because the 250 coils were too heavy that they made less sound than the 200 coil speaker. Now could you imagine heavy rocks all vibrating, crying out in praise to God? That would have been one of the greatest miracles ever performed by our Lord Jesus.

Psalms 150:3-6

“Praise him with the sound of the trumpet: praise him with the psaltery and harp.

Praise him with the timbrel and dance: praise him with stringed instruments and organs.

Praise him upon the loud cymbals: praise him upon the high sounding cymbals.

Let everything that has breath praise the LORD. Praise ye the LORD.”

Harking back to the abstract of this project, what worship experience would be complete without sound? Sound at church is sent to a mixer and then out to the audience through speakers! Speakers seem to be a part of every aspect of our lives now, including in our worship to God!

Hard Lessons

Even a lesson learnt the hard way is a lesson learnt. During this project, I had to try hard to stay patient. This project was interesting, and fun too, but coiling the wire around a paper cylinder 150 times can be trying. Coiling a wire 250 times around a paper cylinder required a different kind of patient.

Acknowledgements

I thank God for giving me the wisdom and resources to work on this project. James 1:5 says:

“If any of you lack wisdom, let him ask of God, that giveth to all men liberally, and upbraideth not; and it shall be given him.”

I thank my parents for helping me with my project.

I thank my grandma, who gave me the phone I used in this project a few years ago.

I thank Mr. David, the person from church who got me interested in how speakers work.

I thank Mrs. Kommu, my class teacher, and Mrs. Trinh, my principal.

I thank East Valley Christian School for giving me this opportunity.

Bibliography

Click the blue links to be sent to the site!

1. Explain That Stuff - Sound
2. Explain That Stuff - Speakers
3. How Great Thou Art - sung by Chris Rice