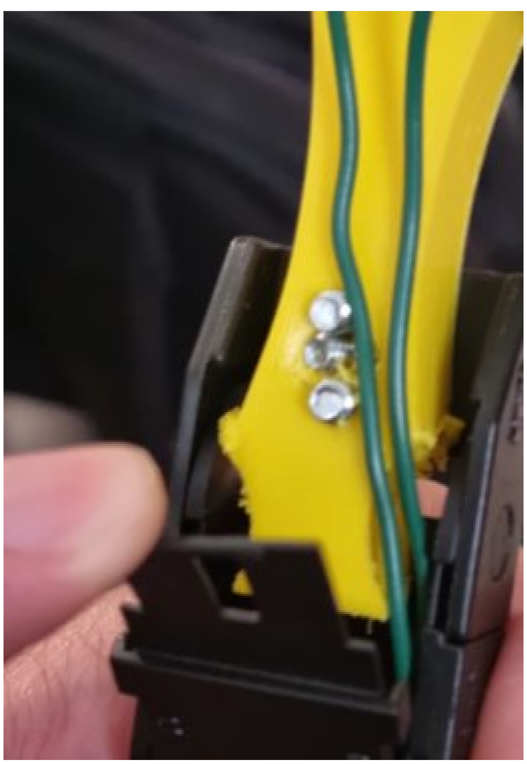
Introduction:

Guitar braces play a pivotal role in both structural integrity and the tone quality of the acoustic guitar. Guitar braces provide structural support, tonal shaping, and control over vibration of the guitar. The design and layout of the bracing can drastically affect the guitar's sound, which determines the balance between bass and treble frequencies and the overall projection and resonance of the guitar. However, not all guitar braces design serves the guitar well. The most common problem of many guitars that has affected the strength and sound quality is over-bracing. Over-bracing can lead to some negative effects on sound quality including reduced responsiveness, reduced overtones and harmonics, reduced projection and structural strength. The most challenging aspect when cutting the guitar brace is lack of precision, crafting these braces require meticulous precision. Lack of precision when cutting and shaping the braces can drastically change the guitar's sound and structural support. It's crucial to be precise when cutting and shaping the brace. For this project, our goal is to design and build the prototype for the guitar brace cutting tool that will make shaving brace more precised. Our project consists of several steps. We will begin conceptualizing the design of the tool, then choose materials the best suited. Next, we will design the schematic to power the tool's motor, ensuring it is fully safe and functional. Once we have all the component, we will begin to assemble out prototype.

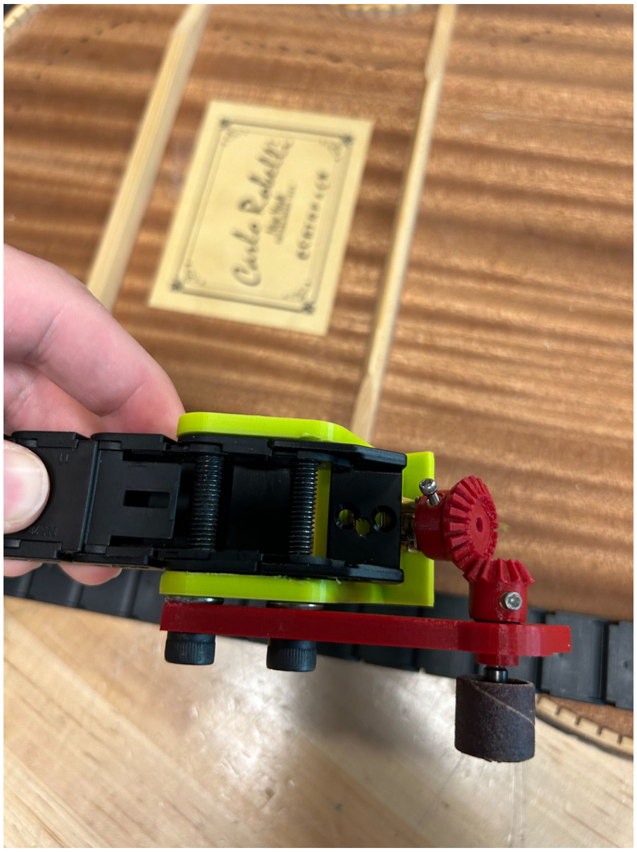
Previous Design:

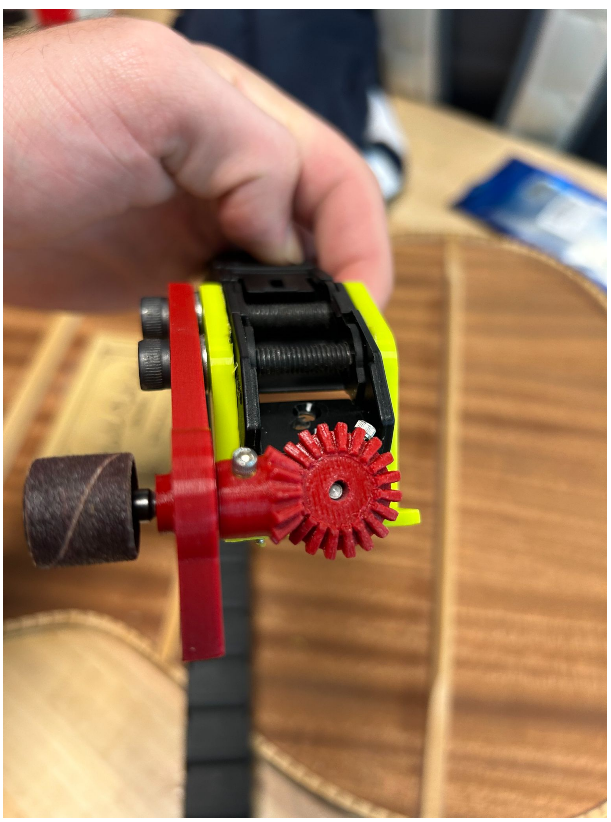
Looking at the previous designs and research, we found that there was not enough stabilization and ease of use in the previous prototype. With the spinning blade, we thought there could be slipping when the blade tries to make contact with the wood. We also came to the conclusion that it would be more difficult to adjust the blade if there was an alternate bracing design in the guitar. Ultimately, we decided to use the energy chain of the previous model so that we could focus on the tool itself. With this, we began to explore the other designs that had been researched.



Current Mechanical Design:

We thought that the sanding method would work the best, while allowing for stability and useability. With that said, we decided to keep the energy chain and just add a new method of removing the guitar bracing. After much thought and many drawings, we came to our current prototype that uses a motor attached to the energy chain by a carrier and linked to the sanding bit by bevel gears. This allowed us to get the necessary speed to sand the wood, while saving space due to the gears being perpendicular to one another. Trying to fit inside the front hole of the guitar was a challenge for us to think about while we designed this. The tool needed to be small enough to fit, but also stable and strong enough to work. We decided that the height of the sanding bit many need to change guitar to guitar, so we have added several footings, ranging in heights, that can extend the tool if necessary. This design will shave off layers of the wood, making it more accurate, easier to use and reduce the possibility of errors. There will also be no chance to slip with the sanding bit, as compared to the spinning blade, making this much safer to use than the previous prototype.  With the first few tests, we have found that the bevel gears will need to be printed in metal, and that the carrier of the motor could also be in metal to prevent breakage, since it is so small. All CAD designs were done in inches with a 0.01 inch tolerance. Below is six pictures that show the design and a bit of wood that was sanded using the tool.



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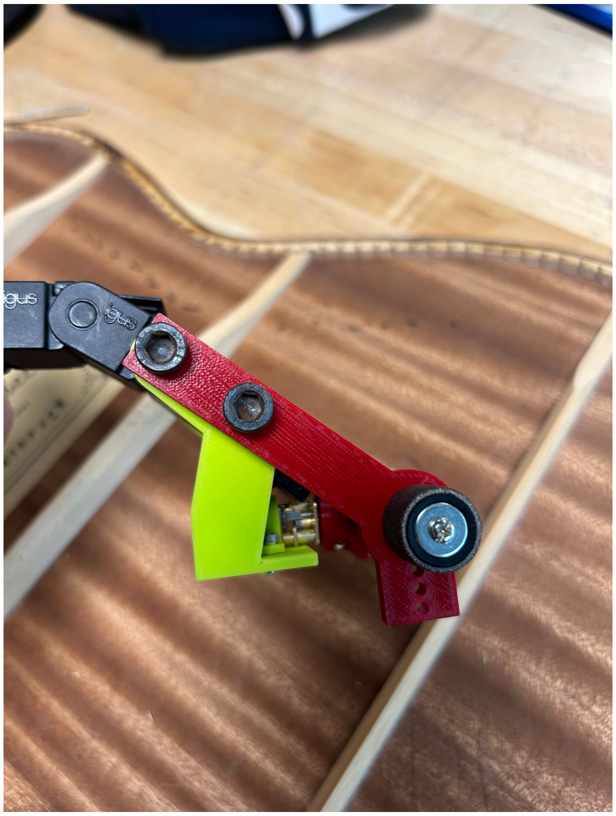
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Motor electric design:

Selecting a good motor for the guitar brace cutting tool is a challenging process, which requires an accurate power voltage and precision. We started by doing some research about the speed requirement to achieve a clean and precise cut on the wood, and we found out that cutting speed to be 3000 RPM. We then researched the optimal voltage requirements, understanding the relationship between voltage and motor's performance metrics. With these specifications, we then looked up for various motors available on Amazon, considering their features for our tool's need. After we bought the motor, we then designed an electrical schematic that tailored to our motor, making sure the motor is successful integrated with the tool's design. Safety is another challenging aspect that we need to consider. We designed a protective circuit, ensuring the wire is fully protected.

Future Plans and Improvements:

As it stands, the current design is entirely made in plastic, so the first step is to either machine or metal 3D-print the gearing (it is also worthwhile to consider machining the other pieces of the assembly). The current size of the tool is limited by the resolution of a 3D-printer, specifically for the bevel gears' teeth. There is a potential for scaling down the whole tool if the manufacturing process has a higher resolution. It is important to note that the current CAD models and designs are adapted for 3D-printing, so there is a possibility that re-models and re-designs will have to be done to make machining more feasible.

The next step is to reconsider the motor selected, replacing it with something more durable for this application without sacrificing the maneuverability of the tool itself. The electric circuit could also be made to have an onboard supply, improving its usability.

An additional “quality of life” improvement would be to add a camera to the system. Instead of mounting a camera to the tool, it would be pushed through the soundhole, and held onto the opposite side through a magnet being held by the operator on the outside of the guitar. This would be similar to an endoscopy camera. This would theoretically provide a birds eye view of the work, giving the user the ability to hold it in place or free hand depending on the application. This was an idea that was briefly explored but not implemented.

The final major improvement would be to explore a better tool body than the energy chain. It is not very sturdy and can be unwieldy/unintuitive to control. Ideally, a new tool body would make it easy for the user to hold the sanding bit up to the brace and move it up or down without falling back down. The energy chain is good at holding the tool up, but is not very comfortable to hold and push back and forth.

Most importantly, the next team should consult a luthier and other experts to evaluate the effectiveness of the tool to accurately develop a second/third prototype.