Design Concept and Rationale

BraceForce is a self-defense tool that can be used and worn confidently by the user. It consists of a length-adjustable string that can be wrapped around the user's wrist like a bracelet, with a small piece of steel attached to one end, and a sleeve with a magnet to house the metal piece on the other end. The metal piece acts like a flail and is swung around by the user to defend themselves, while the magnet and sleeve keep it secure on the user's wrist.

The following subsections will cover the design and rationale of the string, tightening mechanism, metal end piece, and sleeve.

String

The string we chose is a nylon paracord, and it has all of the qualities we wanted from our project definition; it is incredibly strong and durable, but still lightweight and thin, the ideal combination for a bracelet. Another benefit of this string is that it comes in many colors and designs, which can help make the design look better and make the user more comfortable wearing it.

The string loops around the user's wrist three times and extends to a length of 25 inches. The length balances the range of the tool with how easy it is to use. If it is too long, it is more difficult to control and would take more skill or ability to use effectively, but if it is too short, then the user loses the benefit of distancing themselves from the threat. Additionally, having more than three loops would make the bracelet take longer to deploy and more likely to get tangled on the user's wrist.

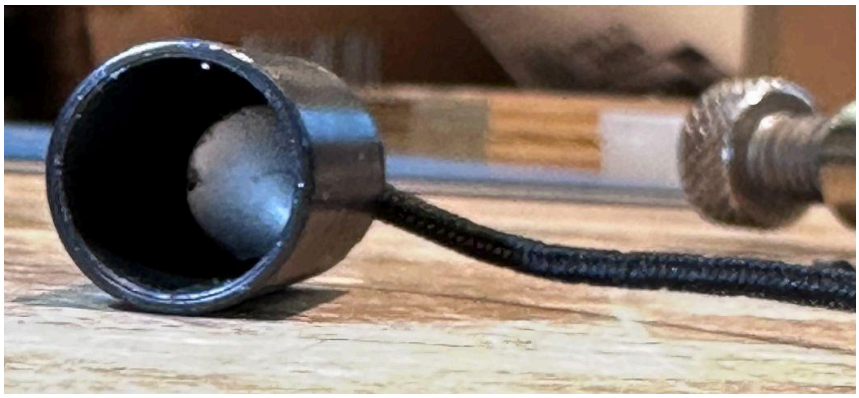

Figure 1: String attached to the sleeve (inside of the sleeve)

Tightening Mechanism

In order to make sure the design remains secure on the user's wrist and doesn't hinder day-to-day activities, we added a way to tighten the bracelet around the user's wrist. This needed to be easily

adjustable to maximize accessibility. Not only does our user base have a range of wrist sizes, but keeping the design simple benefits both users and manufacturers.

We passed part of the string through a small, donut-shaped steel bead that can be slid up and down to increase or decrease the length of the bracelet. However, if the user pulled the bead too much or the tension of the string pushed it out all the way, the bead would fall off the string entirely. To prevent this, we put a zip tie on the loop formed by the bead, which catches it when the string is fully extended.

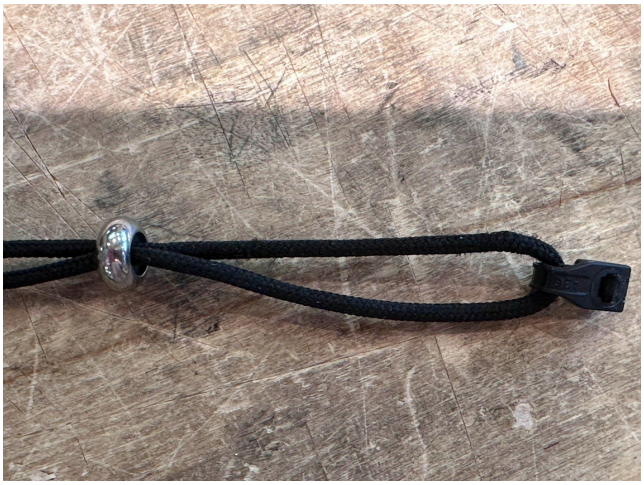

Figure 2: Rubber tightener with zip tie

End Piece

The end of the bracelet, designed to be swung, is made of steel. The piece is cylindrical due to both the availability of material and ease of manufacturing, has a length of 1.125 inches and a diameter of 0.55 inches. This shape we found to be more comfortable to wear compared to shorter and wider variations. Additionally, the piece is light enough, weighing around 5 ounces, comparable to an average wristwatch, to not hinder the user, but still strong and heavy enough to inflict enough damage to deter a threat.

To attach the end piece to the string, we drilled a hole through the center of the piece, threaded the string through, and used general-purpose epoxy to bind them securely. Epoxy was cheap, minimally time-consuming to apply, and easy to use, while still being secure enough to withstand the high-impact usage during testing. Once we let the epoxy set, we shaved it down so that a magnet still stuck to the end, which is important for the design of the other end of the bracelet–the sleeve.

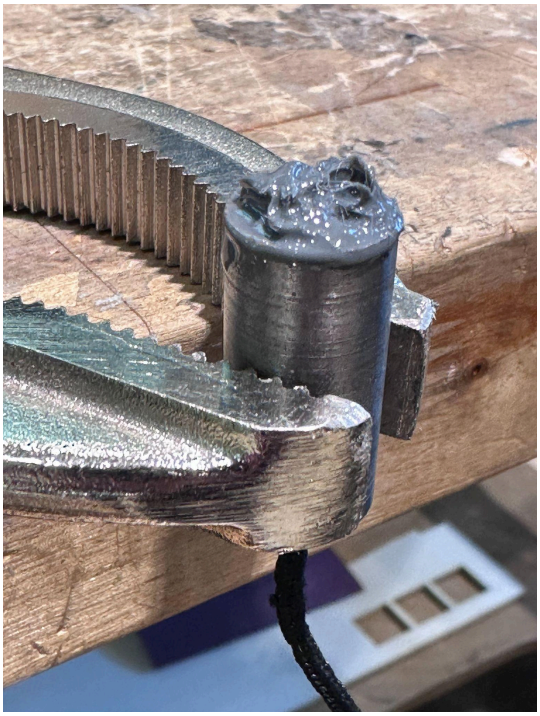

Figure 3: Steel rod with epoxy

Sleeve

The sleeve was designed to function as a clasp for the bracelet, as well as a way to keep the metal piece secure. The sleeve is 3D printed, meaning it is cheap and easily repeatable to manufacture. We then drilled a hole for the string and used epoxy to connect it to the string just like the steel end piece, except we also put a magnet in the sleeve on the epoxy. When the metal piece slides into the sleeve, the magnet keeps it from falling out on its own, but when the user pulls the metal piece out, the magnet isn't strong enough to interfere.

The sleeve also benefits the user in terms of both comfort and aesthetics. We found that the plastic sleeve is more comfortable to touch the user's wrist than the metal piece. The sleeve can also be customized with different colors, and can even be further customized at home by the user (e.g., paint, jewels, etc.). These factors play an important role in making the design more accessible, as the user should feel comfortable and confident not just using the tool, but wearing it.

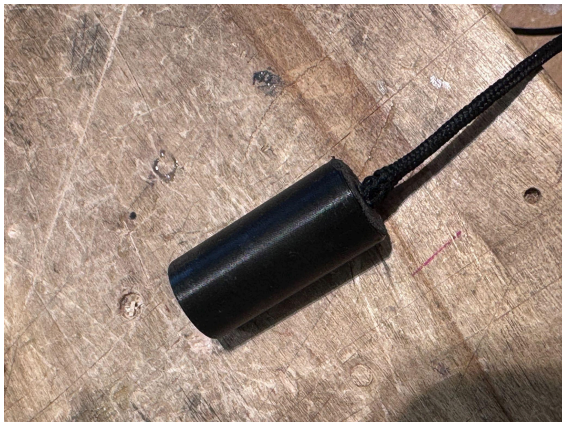

Figure 4: Outside of the sleeve