Switch-Operated Rotating Phone Stand
DESIGN RATIONALE

MACALESTER

Overview and Purpose of Our Project

The design problem that we set out to solve was enabling photographers to capture steady images and videos without manually holding their phone. Many photographers struggle to hold their camera steady, particularly when taking panoramas or recording videos. Our solution was to create a fully functional rotation phone stand, controllable with assistive switches, designed with accessibility, user convenience, and cost in mind. We followed a user-centered design process to ensure the final product would meet the real-world needs of photographers who would benefit from hands-free operation. In this document, we will reflect on each stage of the design process and how our decisions were grounded in design research and principles, and feedback from actual users.

Throughout this project, we were intentional about rejecting outdated models of disability like charity and medical, which frame disabled users as passive recipients of aid or as problems to be fixed. We embraced it more from an inclusive framework, particularly looking at the social and identity models of disability. This model's main point is that disability arises from environmental mismatches and states that the environment is not well suited for the user, and this creates disability. We tried to create something like this that would expand the scope of the environment when it comes to photography, as we are not just making it easier to photograph; there is also a component of inclusivity that comes with an automatic phone stand that others don't have.

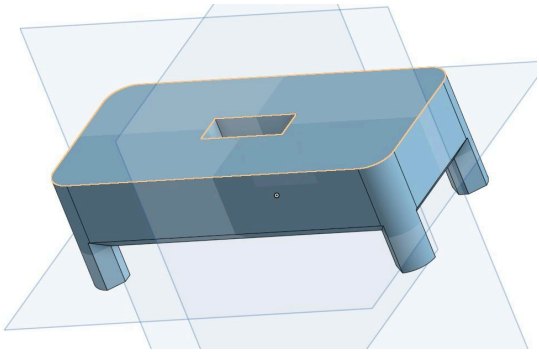
Another aspect was on the topic of Wobbrock's ability-based design, Ladner's emphasis on user empowerment, and Ko's critique of design for the "average user." We prioritized adaptability and personalization in our rationing phone stand. Rather than treat users as test subjects, we involved their input early, particularly during conversations with photographers like Jasper, who directly shared our design priorities for the phone, and when it comes to flexible sizing and mounting angle. We tried to make this a space of co-creation where it was us and the user working together, giving the user visual and functional input into the device's outcome. This was a big point we tried to incorporate throughout our testing

Design Process

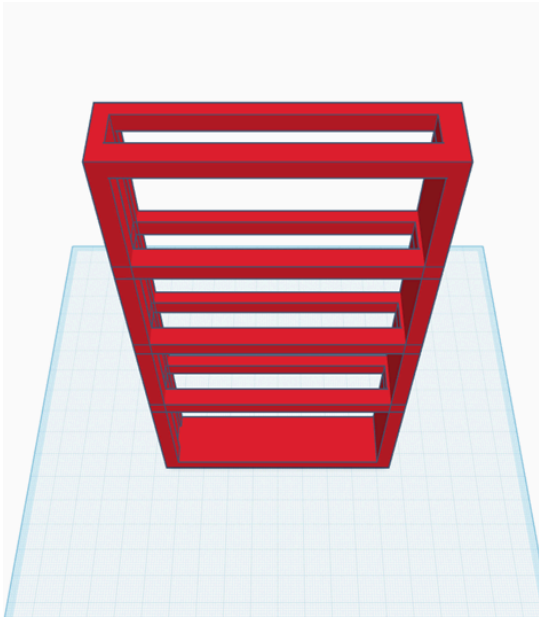
Stage 1: Initial Design Exploration

In order to create this phone stand, users will need access to a 3D printer. The printers we used were the Prusa MK4 and the Prusa MK3S. The user will also need an Arduino board, we used the Sparkfun Redboard programmed with Arduino, because of its USB C compatibility, which gives it almost universal compatibility with any modern computer. You will need to download the Arduino IDE to program this board. Alongside this, you will need 3.5mm jacks and copper wire for soldering. The way we designed this product was to connect to 2 interact

switches from MakersMakingChange. The parts of this project that we designed or adapted are the Servo base, and the Phone stand. We designed the Servo base – the component which holds the servo and hides the arduino board + all of the wiring – using an online software called OnShape. This software allowed us to 3D model using extremely precise measurements, which was how we were able to hold the Servo tightly in place. Here are images of the 3D model for the base:



Next, we found an adjustable phone mounting system online on a website called Cults (link to design). We adapted parts of this model to create a phone stand that could securely attach to the head of our servo motor. The advantage of using this existing design was that it already supported adjustability for different phone sizes and angles. In construct, our original concept, a fixed cage-style holder sized for an iPhone 16 Pro Plus, lacked flexibility and failed to accommodate other devices, as shown here:



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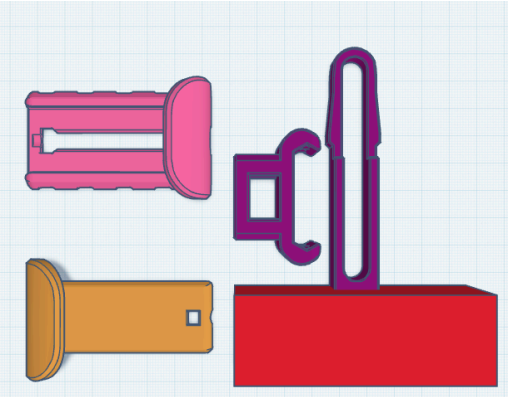
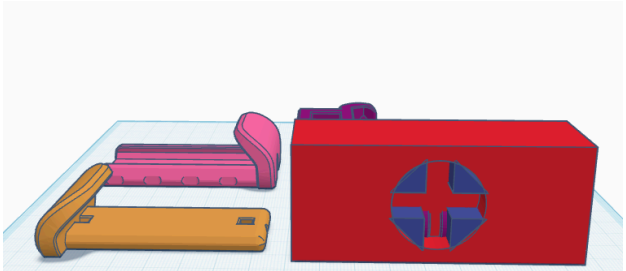
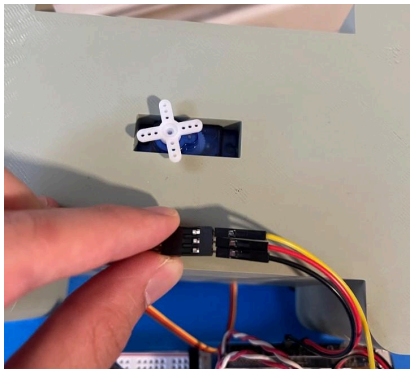
The inspiration came from a FaceTime call with a photographer named Jasper who, when showing him the original concept, cited concerns around the lack of flexibility with phone sizing and also he wanted the ability to be vertical or horizontal. Here is what the new version, based on the Cult phone mounting system parts, looks like from a top and side view:

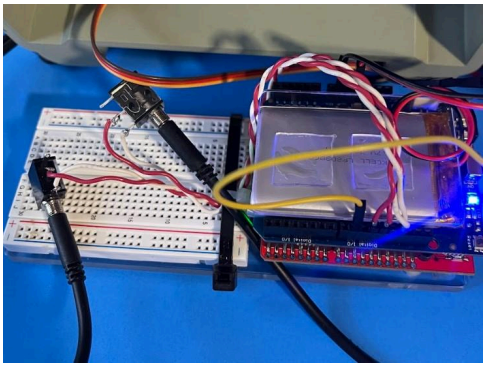




Stage 2: Assemble materials

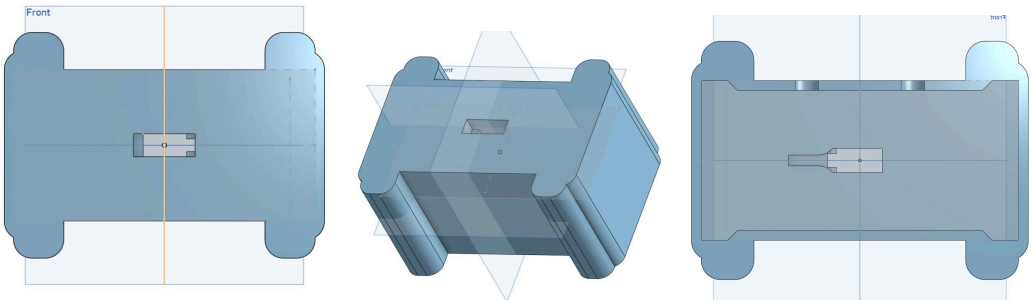
Once all parts of this phone stand have been gathered/printed (using our 3D print guide), the user needs to connect the two switches, as well as the Servo motor, to the Arduino board. The Servo's ground should be connected to the Arduino, and the 5V power should also be connected. Then, the user should use pin 9 to connect the Servo's signal to the Arduino, which allows the Servo to then read inputs from our program. Once this is done, the user needs to connect the switches. To do this, the user will solder each switch to one end of a cable, the other ends will go into the same ground pin (not the same as the servo, but both 3.5mm connections should plug into the same ground as each other), and then each to its own digital input pin. We used pins 11 and 12 for the switches, which you can see in our program. A link to the code we used to run this project is here. The code is quite simple; it essentially takes input (HIGH or LOW) from the switches and then moves the Servo accordingly. Once the wiring is done, it should look something like this:





Stage 3: Iteration

Because we were unable to complete our user testing before any iterations, our group had to make changes based on our own intuition. One of our changes was to update the Servo base so that it was tall enough to completely cover the Arduino board, as well as accommodate the wiring for the switches. This was done once again using OnShape, and by making some precise measurements. Here is what our final design looked like for the Servo base:



Our rationale behind this change was so that users can hide the messy wiring of the phone stand as well as protect the Arduino board from harm. Another adjustment we made was to the phone stand. This was previously mentioned, how we moved from a cage concept to a stand taht was able to adjust sizing and go horizontal and vertical. A minor tweak we had to make was to the sizing of the servo as the original attempt was too big and was loose. Here is a photo of the adaptation we made so that the stand could fit on top of the Servo head:

It is also important to note that our group had to make a very important modification to our choice in Servo due to mechanical failure. Our initial Servo had 360 degree motion, and was controlled using magnitude in a direction. This Servo ended up breaking for an unknown reason, so we had to purchase a different Servo, one with only 180 degrees of freedom which used degrees as motion. While this is not technically an iteration, it is a design choice which we had to make in order to have a functioning product by the end of our deadline.

Conclusion and Future Improvements

Through this project, we were able to learn how to develop a fully functioning 360 rotating phone stand. We were able to understand how an Arduino works, and our ability to write the code and implement it into the architecture of the phone stand. Some future directions that could be of interest in future developments could be fine-tuning the speed of the rotation and having the ability for the user to change the speed manually. In addition, make the stand more sturdy, which limits the ability for it to break or fall off the motor. Finally, have the ability for the user to angle their device up and down to get the most valuable picture. This project that we created made it easier for us to understand our user group and develop something that could be super practical for the average to advanced photographers.