Hardware Report

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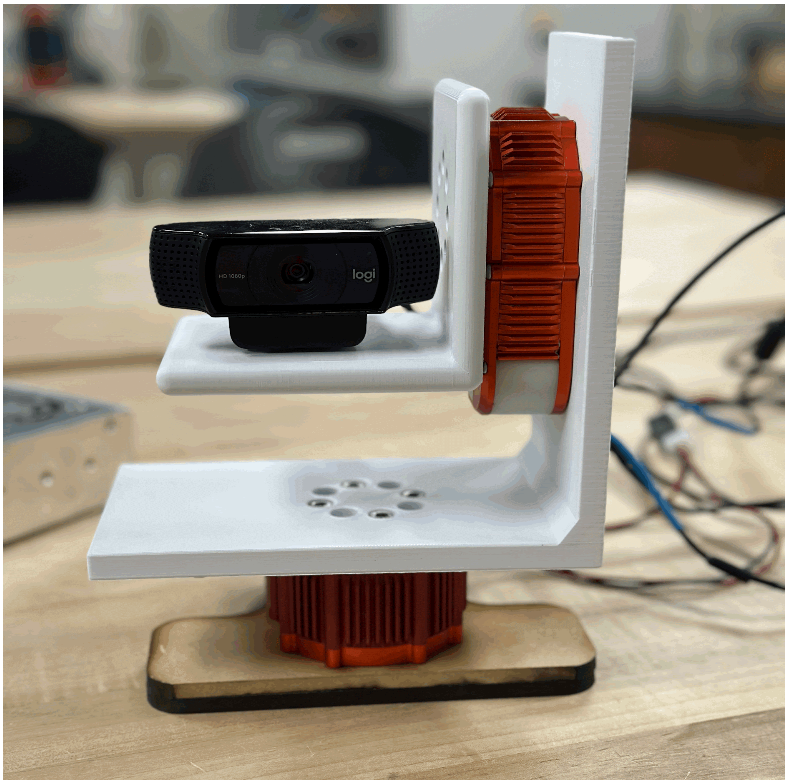
Overview



Our system comprises two primary components: a sturdy base and an upper bracket, both meticulously designed for precision. The bottom bracket features an L-shape and is mounted on a motor, with its upper arm connecting to a second motor that supports the L-shaped upper bracket. The camera is securely positioned on the lower section of the upper bracket. Both components are 3D printed in an elegant white finish, providing lightweight durability. This design allows for precise motion, with a range of movement extending from -2 to 2 radians.

Lower Bracket

Piece of Part	Print Dimension	Actual Dimension
Length x Width x Thickness (Vertical)	98 mm x 8 mm x 178 mm	97 mm x 8 mm x 177mm
Length x Width x Thickness (Horizontal)	168 mm x 98 mm x 8 mm	168 mm x 98 mm x 8mm
Depth x Diameter Motor Clearance Holes	4 mm x 6 mm	4 mm x 6 mm
Depth x Diameter Motor Countersunk Holes	6 mm x 8 mm	6 mm x 8 mm

The holes for the motors were of acceptable tolerance. The 8mm length of the holes allowed for the screws to lay flush with the surface of the bracket. The bracket needed to be reprinted because the hole pattern for the top motor did not correspond to the varying lengths in between the holes. The holes were made 1mm larger in diameter to allow space for the screws. The selected dimensions allowed for the screws to connect the motors securely with the bracket.

The length x width x height of both the vertical and horizontal axes of the bracket were chosen such that the length of the motors would be covered by the bracket. However, we found that the horizontal length was excessive. Though this does not affect the functionality of the robot, we would recommend decreasing the length by ~10mm. We also changed the placement of the top motor after having printed the bracket from having the wire connections facing up to facing down. However, this change made part of the motor stick out from the bracket and left empty space from where that length of the motor was originally covered on the bottom. In the future, we would adjust the placement of the holes to be lower and increase the vertical length of the bracket to cover the motor. Again, this issue does not impact the functionality of the robot.

The thickness of the brackets was chosen such that the screws would completely fit and the structure would be durable enough to hold the vertical motor up. A support was also provided in the design in the shape of a triangular prism connecting the horizontal and vertical parts of the bracket. In the future, we would like to increase the thickness of this support.

Overall, the CAD process for the lower bracket was satisfactory. We would advise others to consider the orientation that they want to put both motors in for the final product before printing out the CAD. The placement of the motors is also dependent on the length of the wires, so taking the direction the wires will face into account beforehand is something we would change. Nonetheless, the overall design turned out well.

Upper Bracket

Piece of Part	Print Dimension	Actual Dimension
Length x Width x Thickness (Motor)	102 mm x 90 mm x 10 mm	101 mm x 89 mm x 10 mm
Depth x Diameter Motor Clearance Holes	4 mm x 6 mm	4 mm x 5 mm
Depth x Diameter Motor Countersunk Holes	6 mm x 9 mm	6 mm x 9 mm
Depth x Diameter Camera Clearance Hole	6 mm x 7.2 mm	6 mm x 8 mm
Depth x Diameter Camera Countersunk Hole	6 mm x 10.2 mm	6 mm x 10 mm
Length x Width x Thickness (Camera)	105 mm x 90 mm x 12 mm	105 mm x 89 mm x 12mm

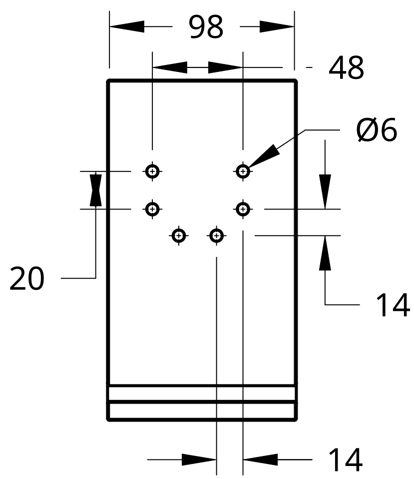
The tolerances for our holes were within acceptable limits. However, they were slightly larger than the print dimensions because we were using a non-digital caliper to measure the dimensions of our piece. We needed to reprint the part at one point because the countersunk holes were too small in diameter, which is how we got these new hole sizes. Our advice to others would be to have your diameter be around 1.00 mm greater than the screws so that the screws can fit in the hole without having to be forced. However, despite the tolerances being off, the print still resulted in snug fits for the nails, and the bracket fits nicely amongst the motor, not too large or small.

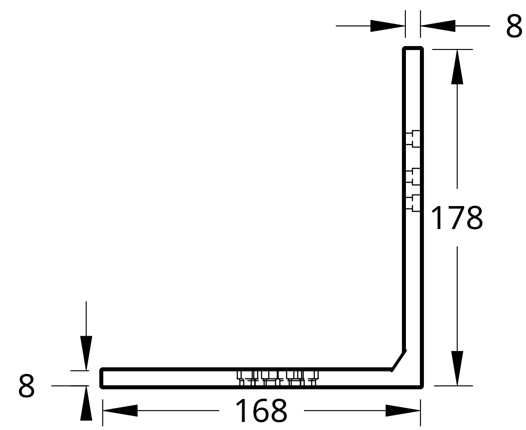
When selecting the overall dimensions, we prioritized functionality and compatibility with other components. We chose a rectangular design for the top bracket, but after observing other teams, we noticed that a circular design was more space-efficient and aesthetically pleasing. Switching to a circular shape, especially for the motor connection, could reduce material usage and create a more compact design without sacrificing functionality. This is a change we recommend for future iterations.

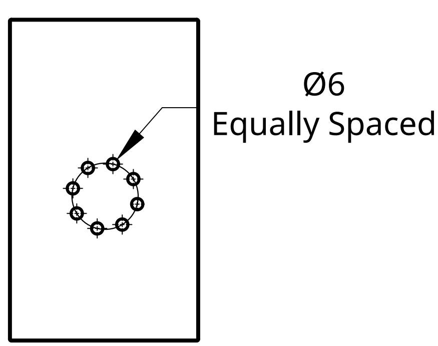
In the bracket design, we achieved structural integrity by ensuring the bottom and top parts of the brackets were thick enough to support the camera's weight; this is why we chose 12 mm thickness for the bottom part and 10 mm for the top part, the top is smaller as it does not need to be as thick and the screws are smaller. However, we could increase the thickness slightly at the bottom attachment point, as the camera feels looser than we would like. While the current design is functional and the looseness does not cause noticeable issues, addressing this detail would improve the overall stability and longevity of the system. Future teams should consider reinforcing this area for added stiffness.

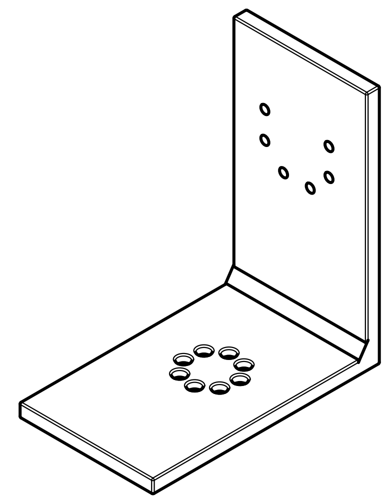
The print orientation influenced certain aspects of the design, particularly the formation of holes, which showed slight size variations that we could have minimized by adjusting the orientation to reduce inconsistencies. While the components met strength requirements, orienting parts to maximize layer adhesion in high-stress areas would improve durability and reduce the need for reprints. A notable challenge arose with the motor mounting holes; our initial design aligned them based on the CAD model, resulting in a misalignment with the motor's zero position and requiring a software offset to correct. To prevent this, future teams should set the motor to its zero position before finalizing the CAD drawing, ensuring proper alignment by adjusting the holes in the model to match the motor's natural alignment, thus avoiding the need for such corrections.

In retrospect, we are pleased with many of the design choices but recognize areas for improvement. For example, we added sufficient fillets to corners to create a smoother look and prevent sharp edges, and we used countersunk screws where possible for a clean and flush finish. These decisions enhanced the final product's structural stiffness and aesthetic quality. However, improving motor alignment and optimizing the thickness are key areas where future teams could make advancements.









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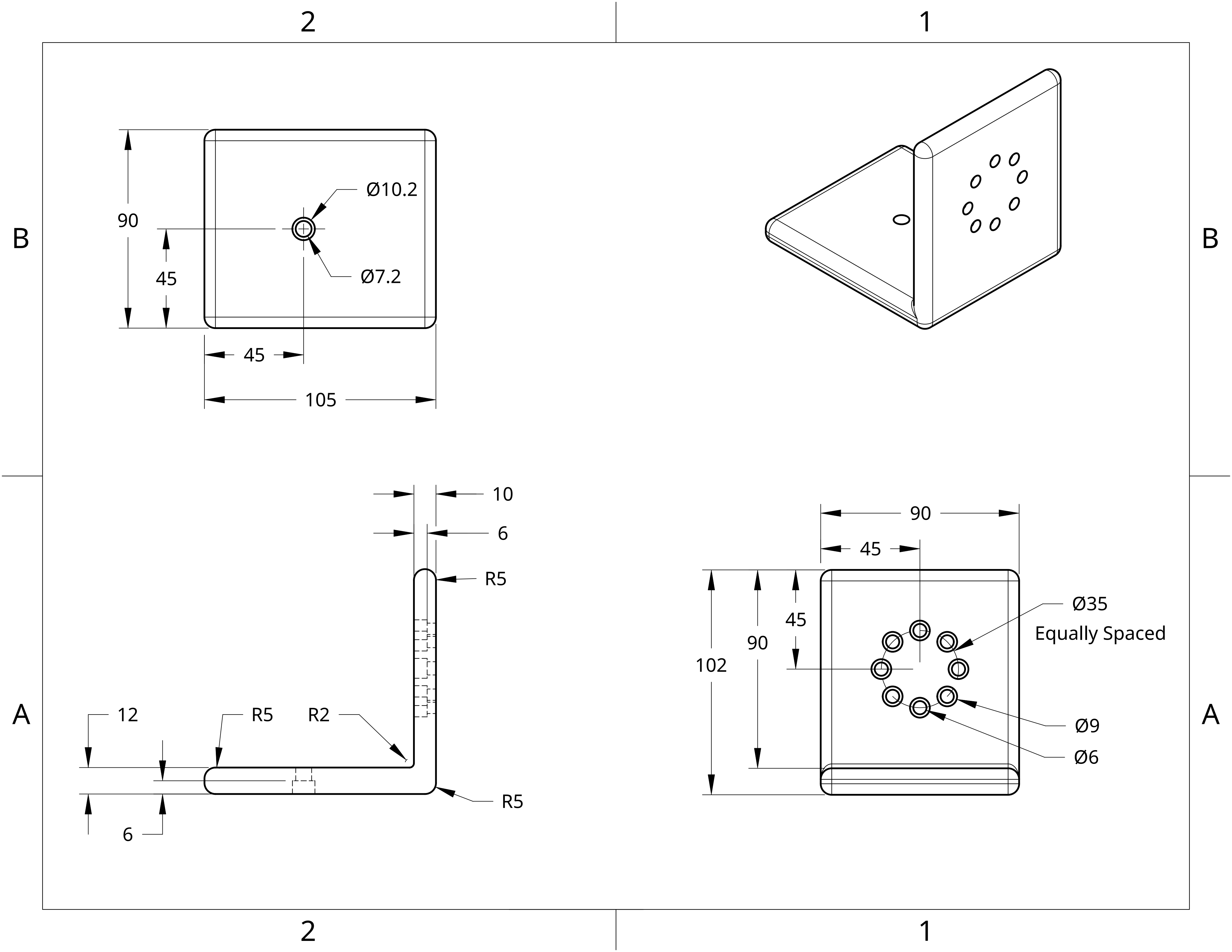
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