WSU GoBabyGo Build Report

Irasema – Spring 2019

Table of Contents

Tools and Materials Used*

Materials

- ride-on car with remote control
- Ablenet 'Big Red' button
- 20A SPST toggle switch
- car seat harness
- ~5 feet ~16-gauge wire (matching the stock wire diameter)
- ½-inch plywood or particle board
- ~30 feet ¾-inch PVC pipe (black; furniture grade)
- 90-degree ¾" PVC pipe joints
- PVC clamps
- various lengths of ¼" bolts and nuts
- ~3 yds black marine vinyl
- male and female shielded wire connectors
- staples
- remote control LED light strip
- upholstery nails
- electrical tape
- black PLA 3D printing material
- 1" black vinyl end caps
- ¼" x 1 3/4" Cotterless Hitch Pins
- 2x small men's belts
- cable ties
- pop rivets
- 45-degree ¾" PVC pipe joints
- ¾" PVC T-joints
























- ¾” PVC pass through joints
- white/translucent tissue paper
- ¾” PVC corner joints

Tools

- standard wrenches, screwdrivers, and ratchet and socket sets

- jigsaw

- sandpaper

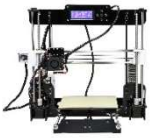
- drill and bit set

- staple gun

- table saw

- sewing machine

- 3D printer



- pop rivet gun

- PVC pipe cutters

- grinder and wire wheel

- hack saw

- metal cutoff saw

- sheet metal brake

- hole saw bits

- scroll saw

- box cutter

- wire strippers

- vice

- countersink bits

- hammer

- drill press

- belt sander

- wood chop saw

**Images are for representation purposes only. They do not indicate the make or model of the tools utilized for this project. Images were not produced for this report or by any build participants and their use is justified under Fair Use laws for nonprofit and educational purposes.*

Build Summary

This electric toy car was modified for Irasema, a two-year old girl with multiple diagnoses that require her to use a ventilator and limits her mobility. With this in mind, several key modifications to the car were made and are shown below. Notable features include a quick-release storage bay off the back of the car for carrying Irasema's ventilator or other equipment, an adjustable tray table with an internally lighted button for easy throttle activation, and a harness mounted to a PVC frame for added seating support.

The ride-on car selected for modification was a Uenjoy model HP002 in the pink color. It was purchased for approximately $225. This vehicle was selected for its having several desirable features out of the box. The most notable of these are remote operation capabilities and a large weight capacity (88lbs). The vehicle, before modification, along with some seller details is shown below. Note that the model HP002 car's RC circuits are such that the remote can override manual inputs, even when the car is in manual mode. This is highly desirable for a GoBabyGo car, particularly for those children who are unable to steer for themselves. This car has now been used in several GoBabyGo builds and has proven to be an ideal car for modification.

Uenjoy Ride on Cars 12V Children's Electric Cars Motorized Cars for Kids with Remote Control, 3 Speeds, Head Lights, Model HP-002, Pink

https://www.amazon.com/Uenjoy-Childrens-Electric-Motorized-Control/dp/B07FC6LGCS/ref=sr_1_2?keywords=uenjoy+jeep&qid=1550285454&s=gateway&sr=8-2

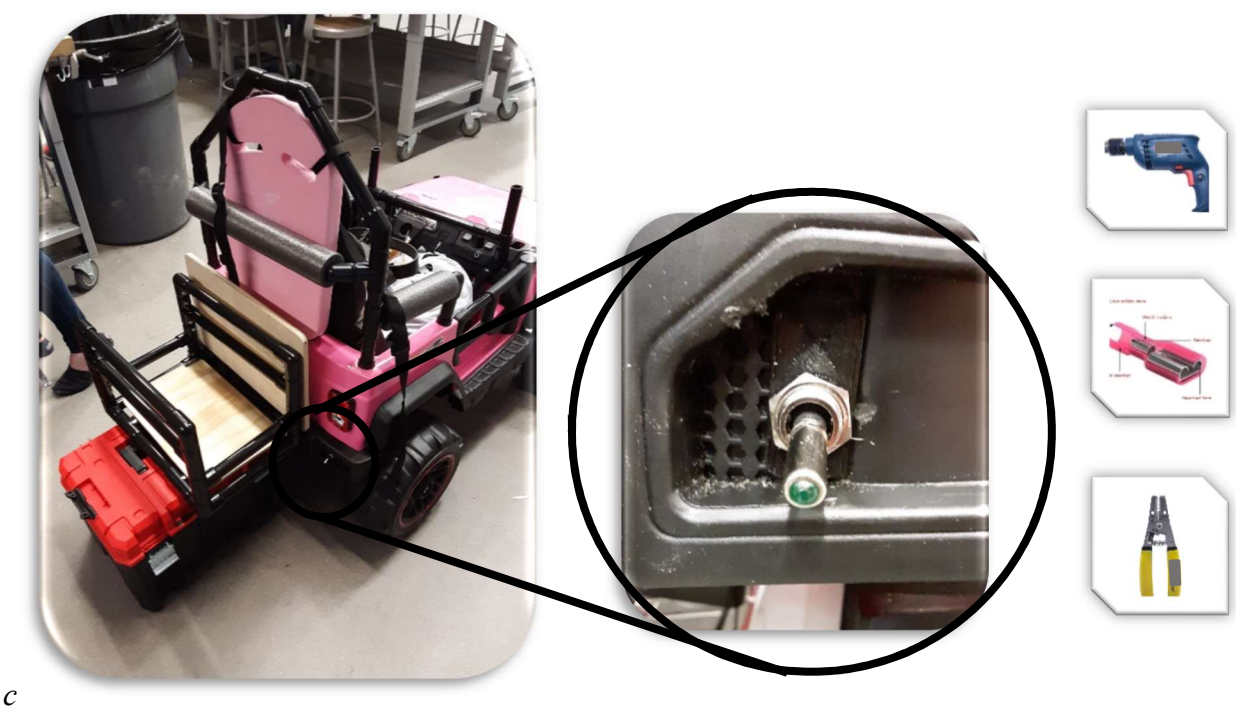
Est. Delivery: ~February 23-28

$224.99

- Cars Speed: Contains 2 forward gear & 2 reverse gear manually and 3 speed gear through remote controller. Car Speed: 2.5 mph - 4 mph, smooth & simple to ride. Kids can drive it on their own by foot pedal and steering wheel, or parents control it by a remote controller.
- Safety: Wheels are equipped with a spring suspension system to ensure a smooth ride. Ideal for both outdoor & indoor playing. Parents remote control and double door design able to ensure your kid's safety.
- Product Size: 49.2" * 31.5" * 31.5". Maximum Load: 88 lbs. Car Battery: 12 V 7 AH* 1. Make sure to switch the gear button from R/c to manual in case the child wants to self ride the car while using the gas pedal and steering wheel , and the same procedure to go back in R/c mode to use the remote controller.

Kill Switch Wiring

A kill switch is a standard addition to GoBabyGo cars as a stopgap for car malfunctions and situations that might otherwise result in a runaway. For this purpose, a standard 20-amp toggle switch (Figure 1) was mounted on the back of the vehicle in an indent at the bottom right corner of the bumper to serve as an easily accessible kill switch. When the switch is in the 'off' position, power to the car is cut off and it cannot move. When the switch is flipped to the 'on' position, normal power levels are restored and the car regains full functionality. The switch's terminals were spliced into the ground wire off the main battery such that the switch need not be in the 'on' position for the vehicle to charge. Note that approximately 2.5 feet of additional wire had to be added to the splice in order to reach the desired switch location. Shielded connectors were used to make all connections in order to preserve accessibility of the work for any future troubleshooting or modification that may be necessary. The switch is ideally mounted using a single whole drilled just large enough for the head of the switch to pull through from behind the bumper (Figure 1). It is then secured using the provided nut (and washer, if applicable).



c

Figure 1

Roll Bar and Harness Mounting

A 'roll bar' was constructed as shown in Figure 2 from ¾" black schedule 40 PVC pipe using two 90-degree fittings, four T-joint fittings, and six 45-degree fittings. In addition, approximately 7-8 feet of straight PVC pipe was required to construct the roll bar. This bar served as the upper mounting point for the seat harness as well as a support structure for a kickboard that provides support for the mid-back of the harness. Black pool noodles were used to cover the 'arms' of the roll bar for added comfort. A schematic drawing of the roll bar is shown in Figure 3. PVC pipe cutters were used to create straight PVC pieces of appropriate length. The frame was mounted at the four locations originally intended to mount the rear driving lights on the car. With the original lights removed, the new frame was designed to align with the leftover slots. Two 90-degree joints were cut in half and the uneven end of all four pieces were ground down using a belt sander to act as shims between the PVC frame and the mounting holes in the car's body.

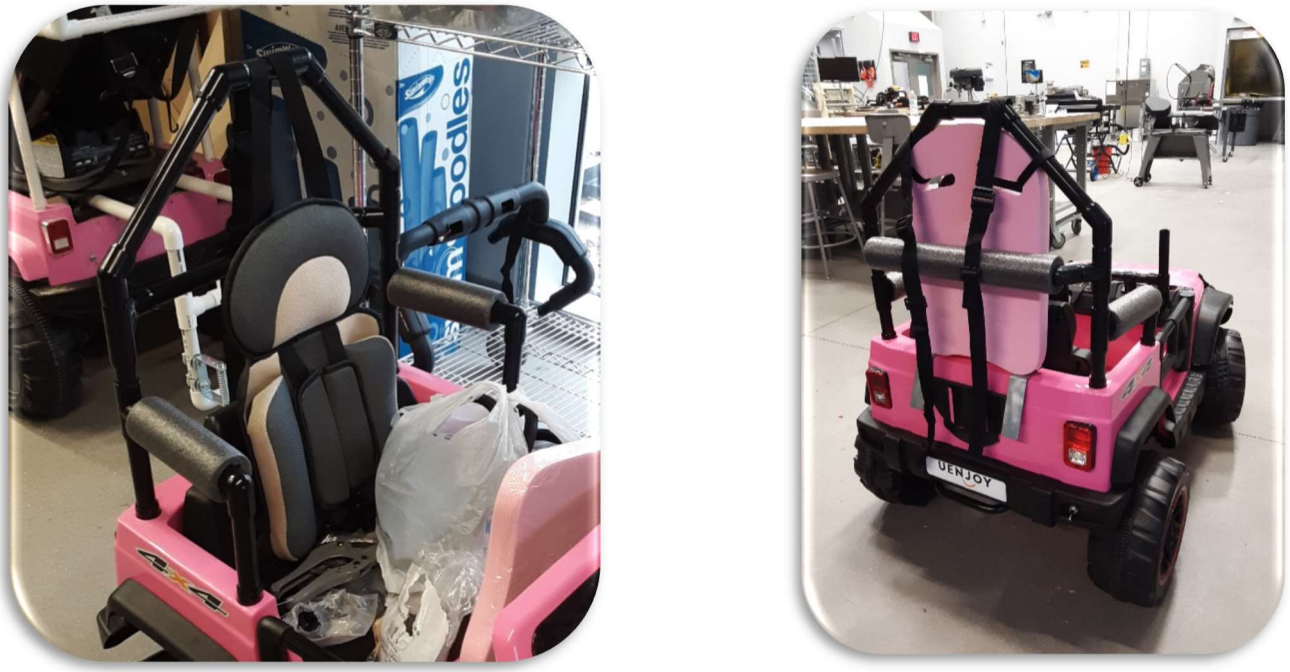


Figure 2

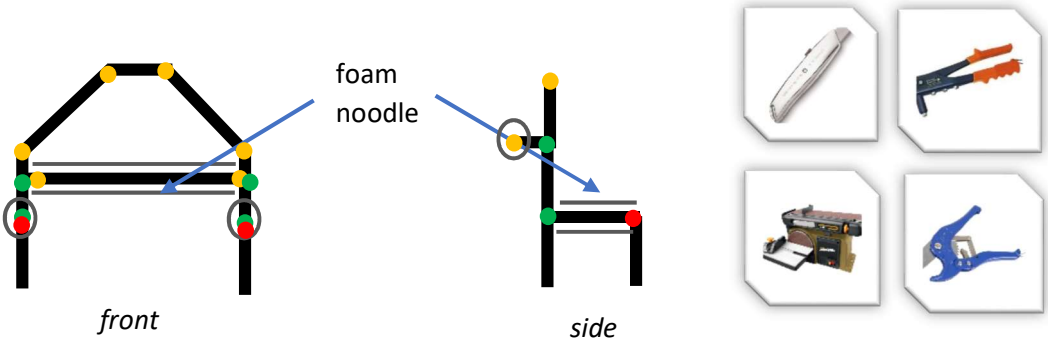
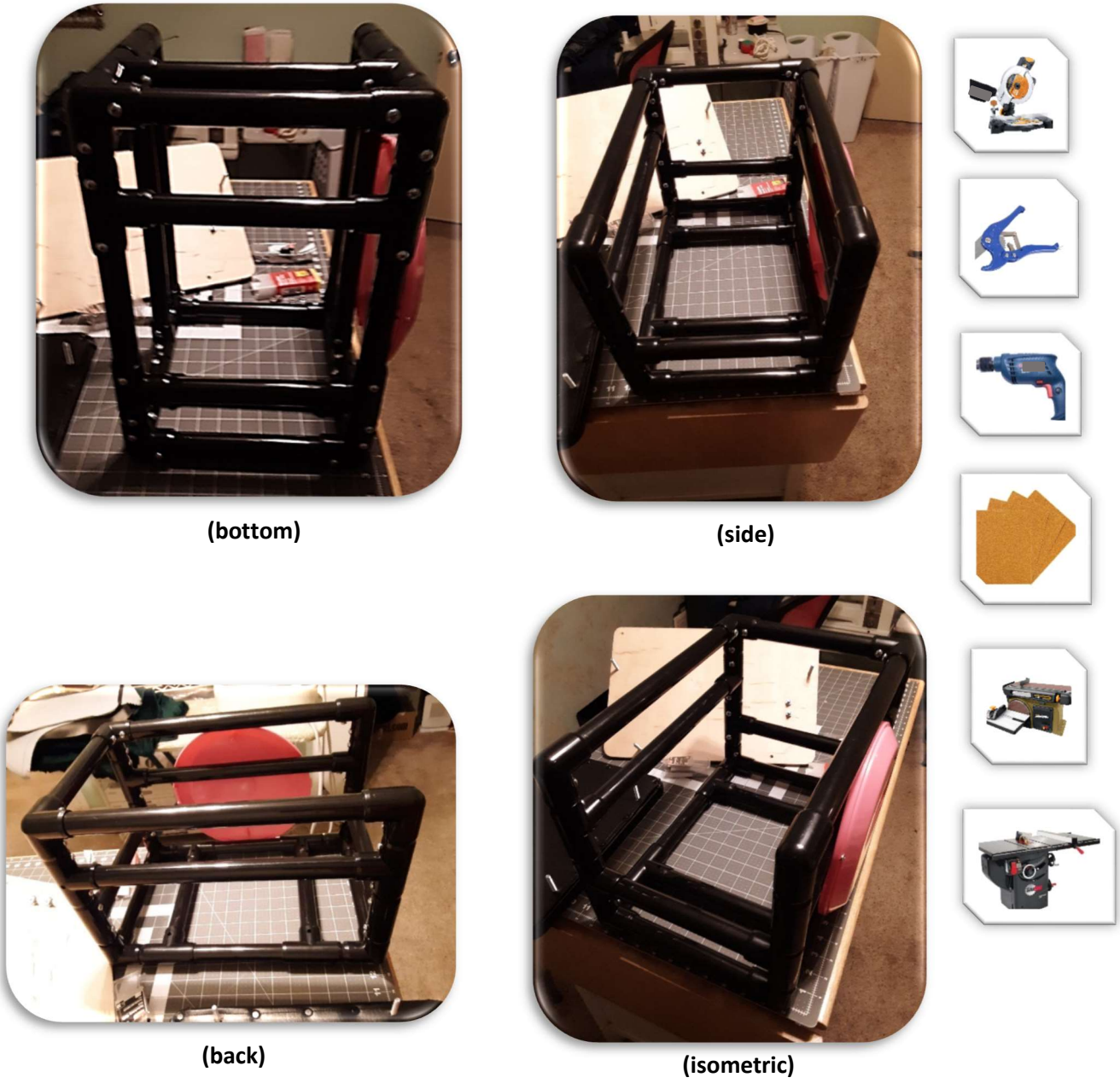


Figure 3. *A schematic drawing of the PVC 'roll' bar. Yellow circles indicate 45-degree joints, red circles 90-degree joints, and green circles T-joints.*

Storage Bay Build

The storage bay was also constructed from black ¾" furniture grade PVC pipe. The project required approximately 15 feet of PVC pipe along with six corner joints, two 90-degree joints, and twelve T-joints. The storage bay's finished PVC frame is shown below in Figure 4. The dimensions of the bay were based on measurements taken from Irasema's ventilator with an additional inch added to each side.



(bottom) **(side)** **(back)** **(isometric)**

Figure 4

The next step is to create a wooden base plate and vertical mounting plate to which two metal hooks can attach (Figure 5). The base plate can be constructed out of any suitably thick wood, but in this case, a ¾" thick particle board was used. The inside dimensions of the PVC frame were measured and table and chop saws used to make straight cuts followed by a belt sander for rounding the corners. Finally, the board was finished with sandpaper over all edges to prevent tearing of the vinyl during upholstery. The base plate was mounted to the PVC frame using four ¼" carriage bolts through holes drilled in each of the four base plate T-joints (Figure 7). Make sure the bolts are of sufficient length to protrude slightly from the bottom of the joints. If the bolts are too short, a countersink can be applied as shown in Figure 6. If the bolts are too long, use a hack saw and vice to cut the bolts down. If the latter approach is taken, be sure to use a grinder and wire wheel to smooth the sharp edges of the bolt after the cut.

A mounting plate (Figure 8) was constructed with ½" plywood by tracing the forward-facing side of the PVC frame onto the wood and cutting with a table saw and finishing with a jigsaw. The edges were smoothed with sandpaper. The wooden plate was mounted to the front of the PVC frame in four locations with ~2" long ¼" carriage bolts with the heads of the bolts facing the car. Note that these bolts will likely need to be cut down and finished with a wire wheel as well.

Finally, two mounting hooks were created for attaching the storage bay to the back of the car (Figure 5). These were fabricated out of scrap galvanized steel. The two hooks were carefully formed using a sheet metal brake for the two major bends creating the hook structure followed by a vice and hammer for the more subtle bends made to clearance two bolt heads used for mounting to the storage bay's wooden plate. Four holes were drilled in the bay's mounting plate corresponding to four holes on the hooks (two on each). The hooks were positioned such that they aligned reasonably well with the two holes on the inside of the back wall of the car that were originally intended to aid in mounting the seat. The holes were carefully widened with a box cutter to accommodate the wider and more centrally located hooks so that the hooks would cleanly slide into the holes.

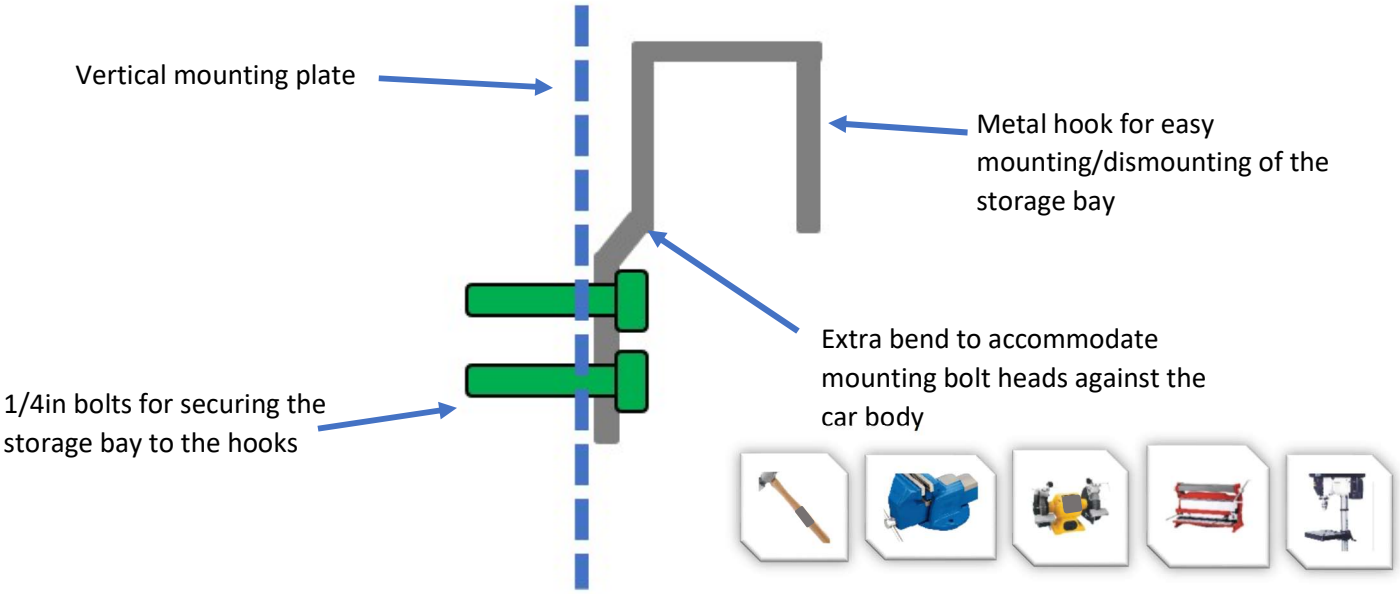


Figure 5

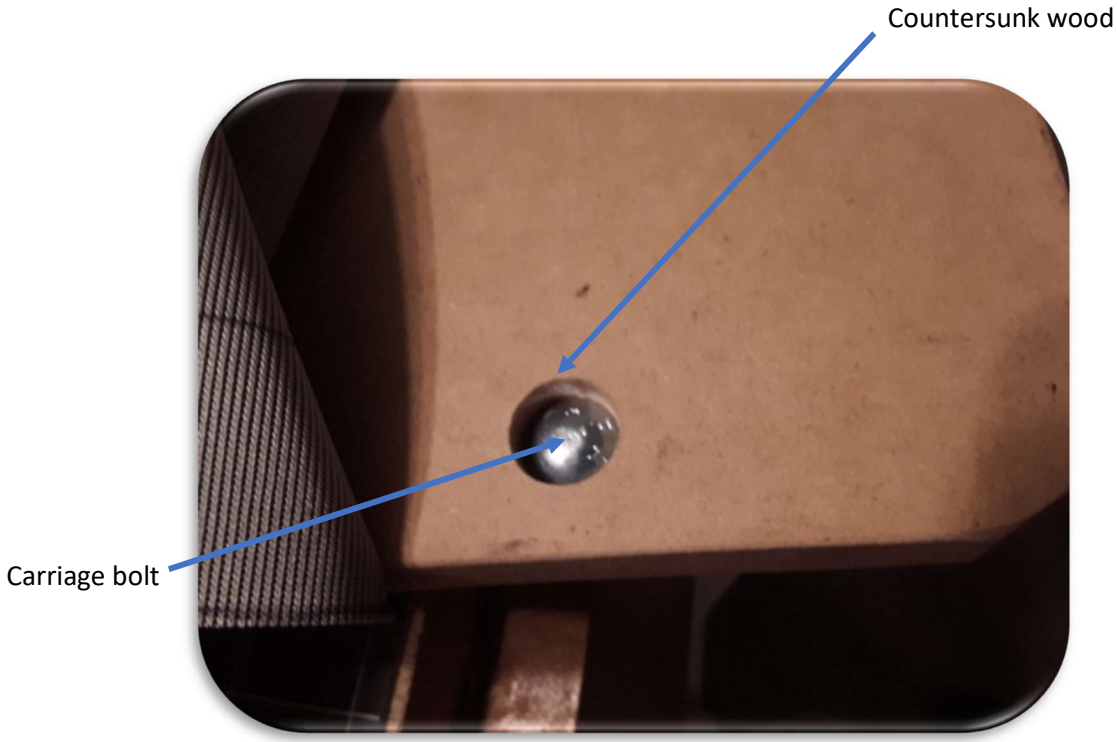


Figure 6

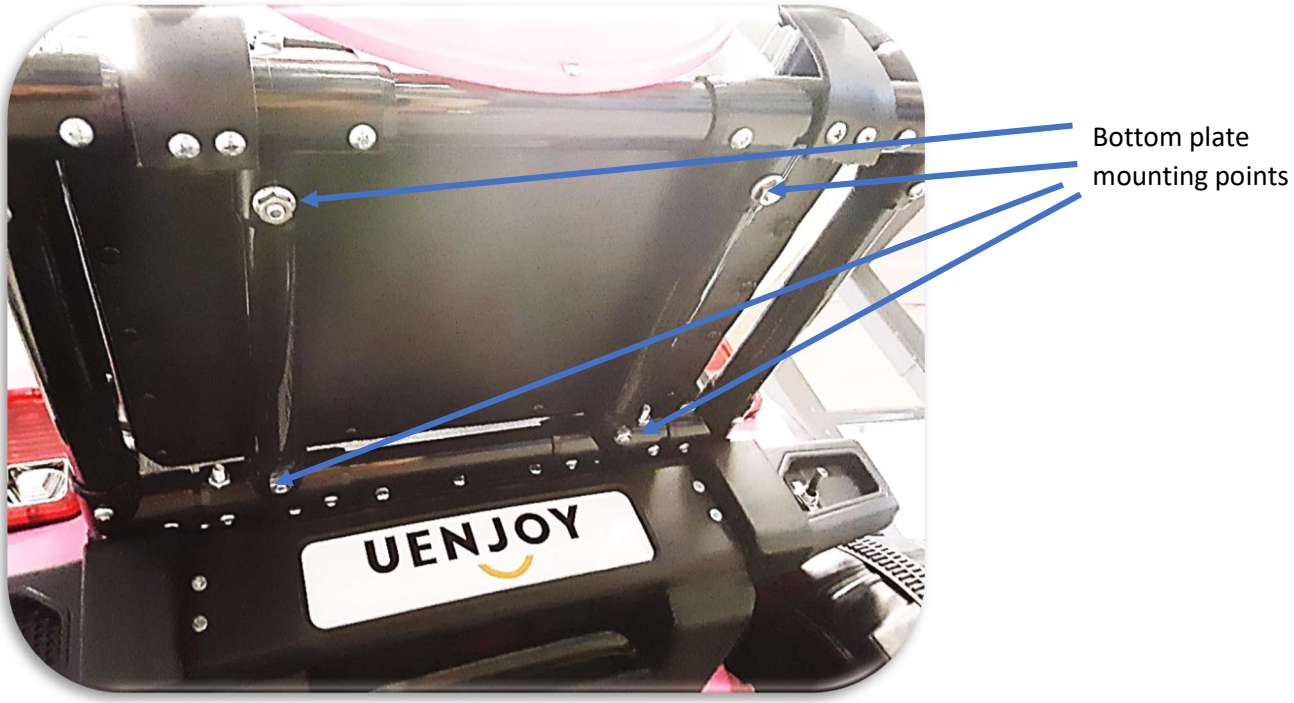


Figure 7

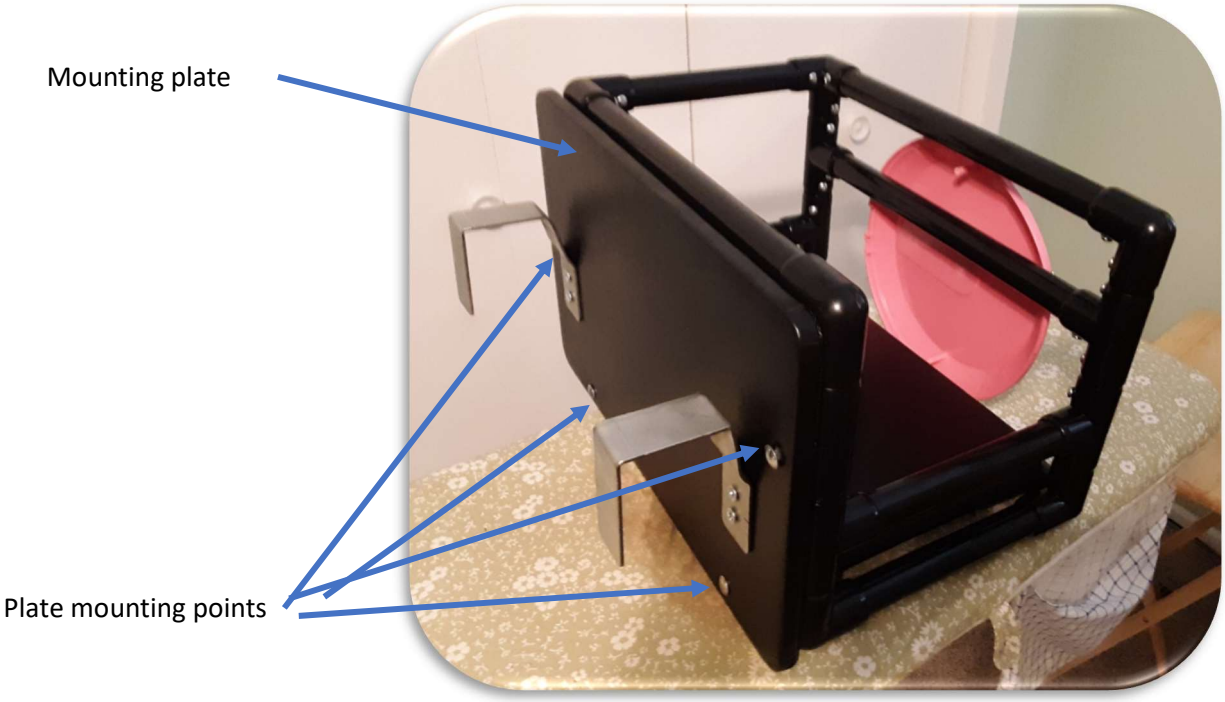


Figure 8

Tray Table Build

The frame for the tray was constructed primarily from ¾" PVC pipe and associated connectors. The frame's primary mounting points were at 5 locations under the floorboard of the car (Figure 9). The pipe was secured to the plastic body of the car at each of these locations using ¾" PVC pipe clamps and two ¼" bolts. The stability of the frame was increased using 3D printed brackets (Figure 10). A schematic drawing of the design is shown in Figure 11. Note that 1-inch soft vinyl caps were used to cover raw ends of the PVC pipe. Near the top of the frame, a crossbar was added and secured at both ends using ¾" pass through joints. Five holes spaced approximately ¾" apart were then drilled near the top of the vertical support tubes on both sides. Corresponding holes were drilled at the same time in the pass through joints such that a cotterless key could be used to secure the cross bar at different heights, allowing for adjustment of the tray's vertical position. Note that it may be necessary, as was the case with Irasema's build, to incorporate back-to-back 45-degree joints midway up the vertical supports to position the tray far enough away from the driver while avoiding contact with the dashboard. Finally, two pass through joints were slipped over the horizontal support bar immediately followed by two 90-degree joints. The tray support was constructed using four 45-degree joints (Figure 12).

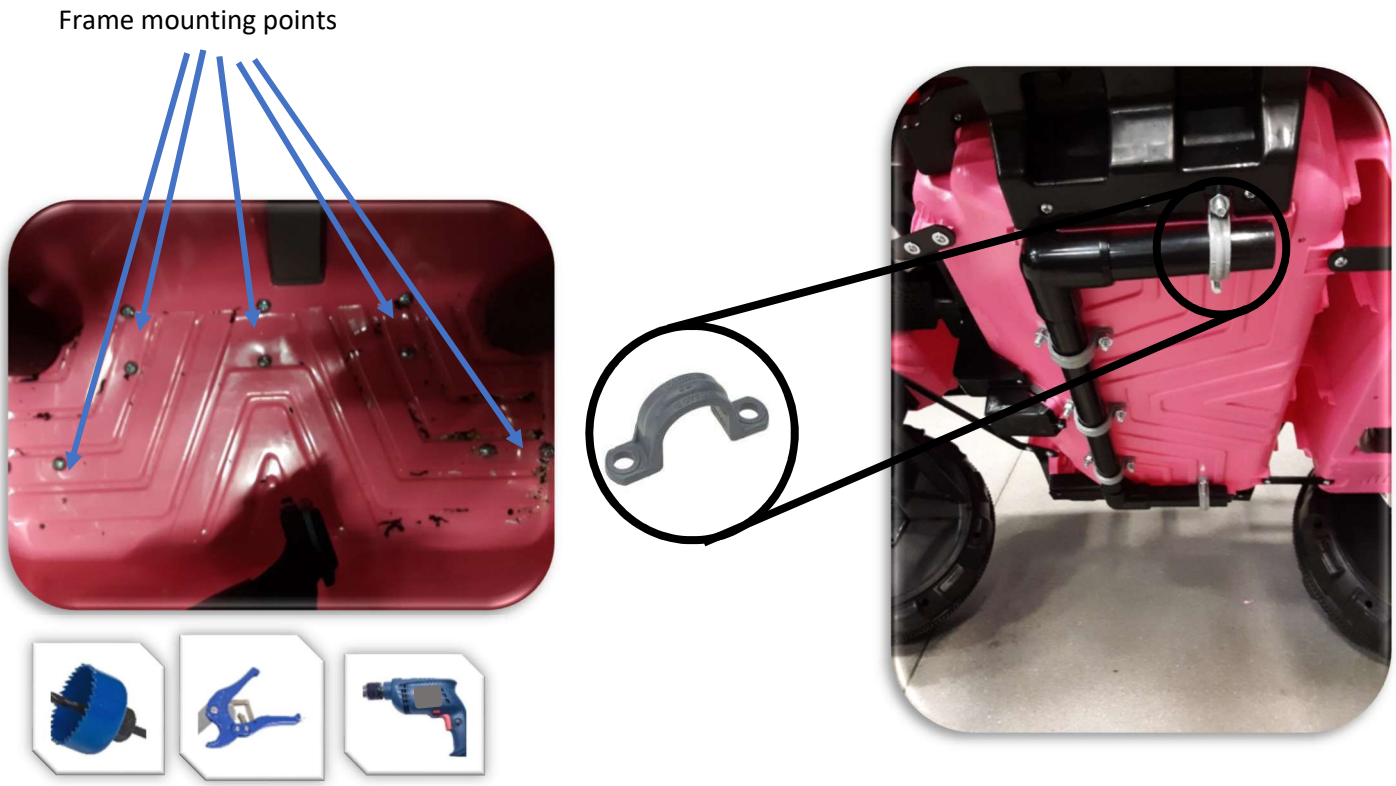


Figure 9

Figure 10

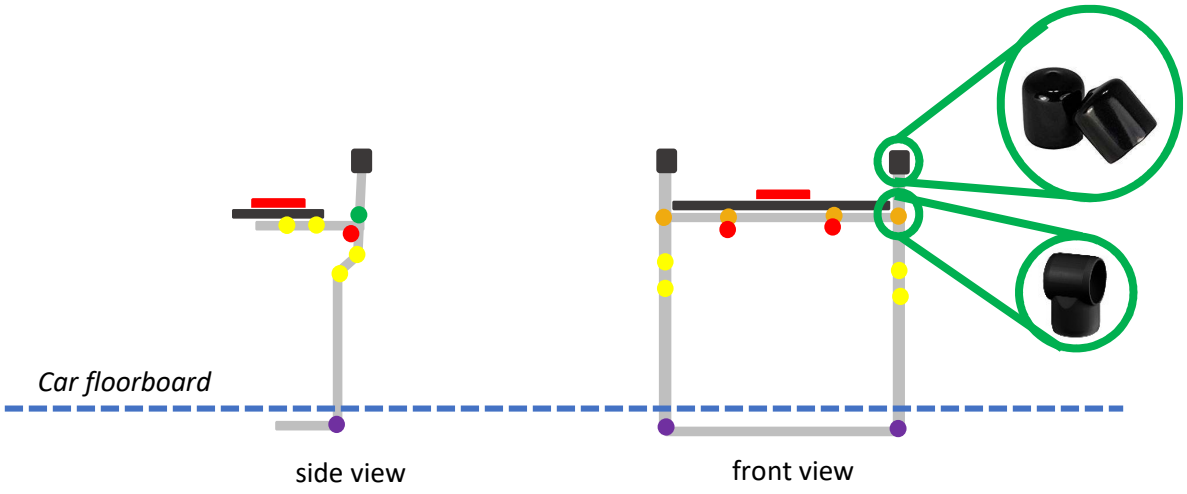


Figure 11. *Schematic drawing of the PVC support structure used to mount the tray and button. Green circles indicate T-joints while purple circles indicate corner joints. Orange circles are pass through joints and yellow circles are 45-degree joints. Finally, red circles are 90-degree joints.*

The tray table was constructed from ~3/8” wood. A pattern for the table was freehanded and cut out using a jigsaw. Sandpaper was then used to smooth the sharp edges in preparation for covering with vinyl. The general form of the table can be seen in Figure 12.

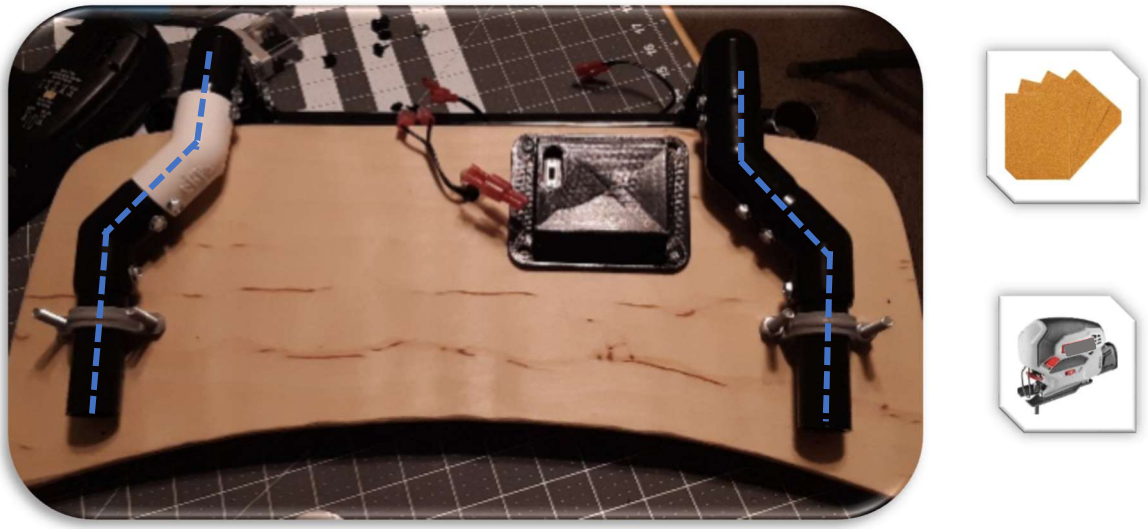


Figure 12

Mounting the Tray

The frame was attached to the tray using the same clamps and ¼" carriage bolts (installed before covering the tray with fabric) as shown below in Figure 13. The carriage bolt heads were pulled into the wood with a nut before covering the tray with vinyl as the vinyl was applied over the bolt heads. The finished mount is shown in Figure 14. The heads of these bolts could be countersunk in future builds so that the vinyl lays flush with the wood after covering.

bottom view

top view

Figure 13

Figure 14

Upholstery

All exterior wooden components were upholstered using black marine vinyl. The general steps taken to accomplish this for a single component are roughly shown in Figure 15. First, the finished wooden component was traced onto the rough side of the vinyl. Then, the fabric was folded at the traced line over the wood and a second line exterior to the first marked such that approximately ½" of vinyl was allowed to wrap around the back side of the wood. Then, corners were notched at regular intervals using scissors so that they would lie flat when wrapped around the wood. A staple gun is used to secure this piece to the wood by wrapping the vinyl around and stapling in place so that the vinyl is tight. In this case, staples were used approximately every half inch around the component's perimeter. A small hammer was used to tap in any staples left protruding from the wood when finished. Next, a second piece of vinyl was traced around the component and a second line again marked exterior to the first. This time, the second line was approximately 1/2" outside of the first. The vinyl was then folded onto itself over the interior line and sewed in place to hide the raw edges. Finally, the sewed vinyl was fitted on the back of the wood component and secured in place using ½" black upholstery nails or #8, 3/8" pan-head screws (Figure 16), whichever was a more appropriate length for the wood being covered (be sure that the fastener you choose is short enough not to protrude out the front side of the wood).

Figure 15

Figure 16

Internally Lighted Button

The internally lighted button consists of two primary components: the Ablenet 'Big Red' button and a remote-controlled LED light strip with battery pack. First, a small whole just large enough for the LED light's control circuit to fit through was drilled the midway to the edge of the Big Red button's plastic bottom cover. The light strip is then trimmed so that approximately 3 turns of the light strip fits comfortably inside the button as shown in Figure 17. The light strip was carefully curled into button such that the button still activates normally. This required that the light strip was lying nearly flat on the bottom of the button. The battery pack is then mounted on the underside of the tray table as shown in Figure 18. A 3D printed case was used to secure the stock case to the table. The power lines were then fed through a ~3/8" hole drilled in the tray table just beneath the hole in the button. To enable this, the power lines had to be cut and reconnected using two male and two female shielded connectors. This also allows for the adjustment of the length of the power lines so that they are nearly without slack when the button and battery case were securely mounted.

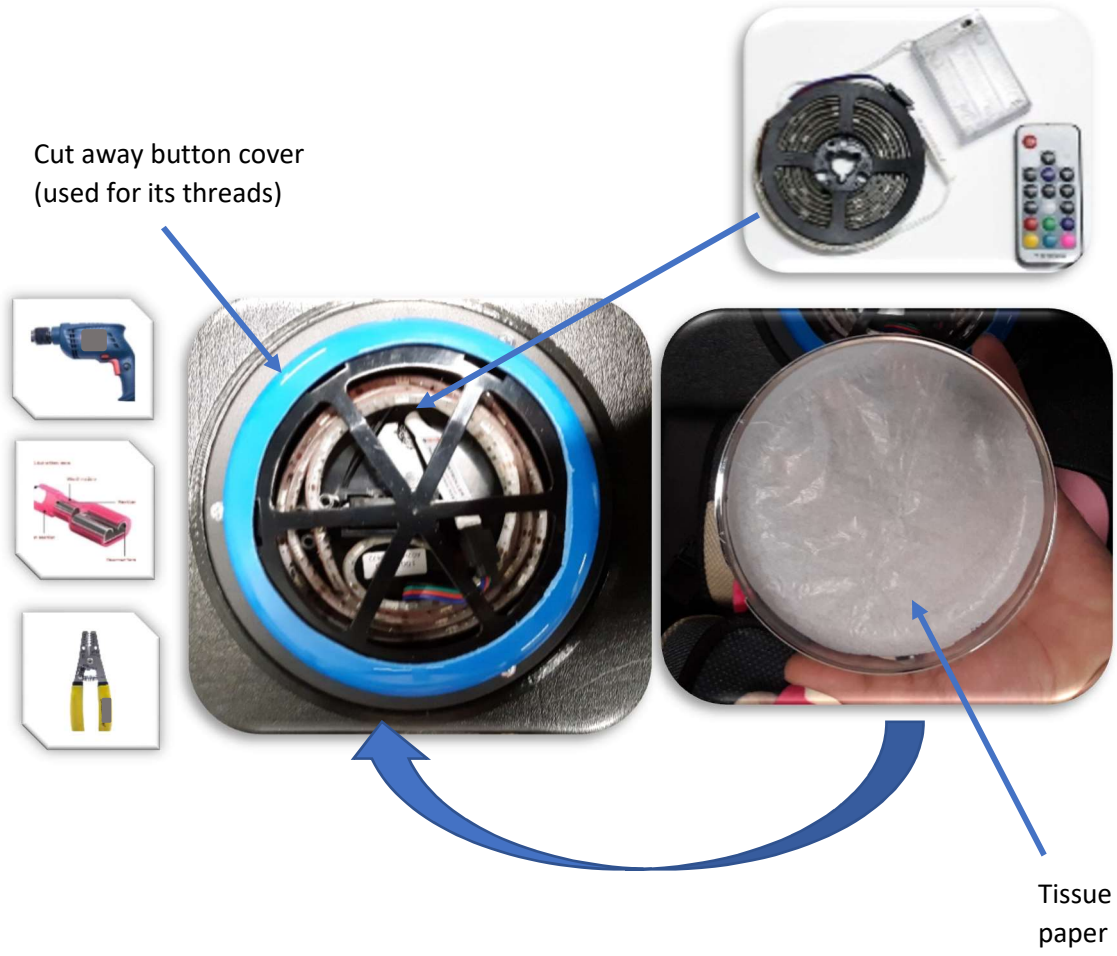


Figure 17

The translucent button top was created by cutting away the central portion one of the original replaceable colored plastic pieces so that only a small brim with threads remains. This was accomplished by drilling a hole in the central portion of the plastic so that a scroll saw blade can be fed through and used without breaking the ring's continuity (Figure 19).

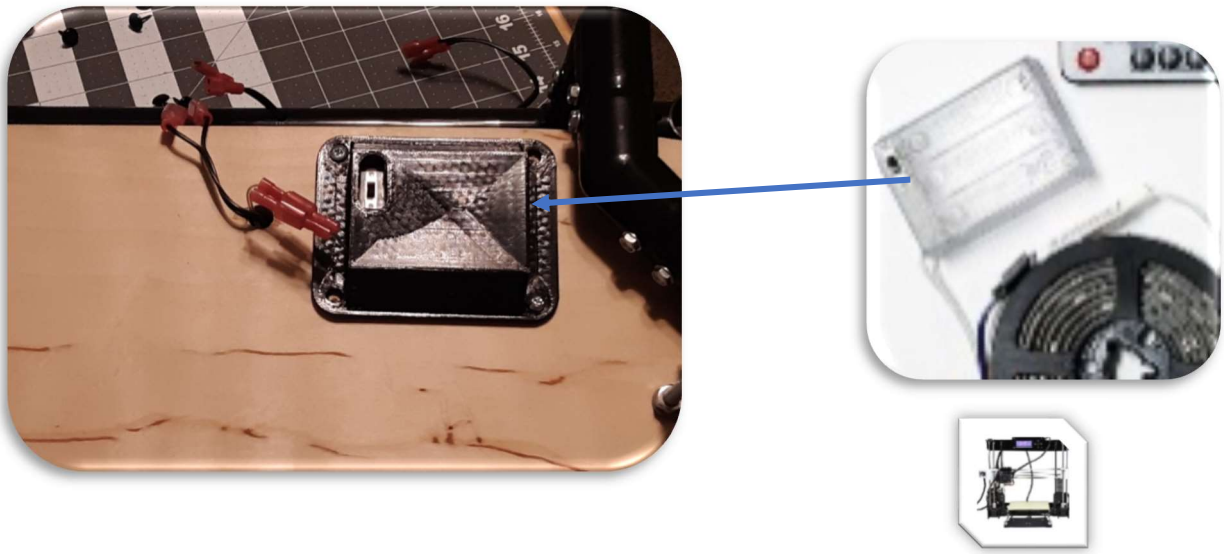


Figure 18

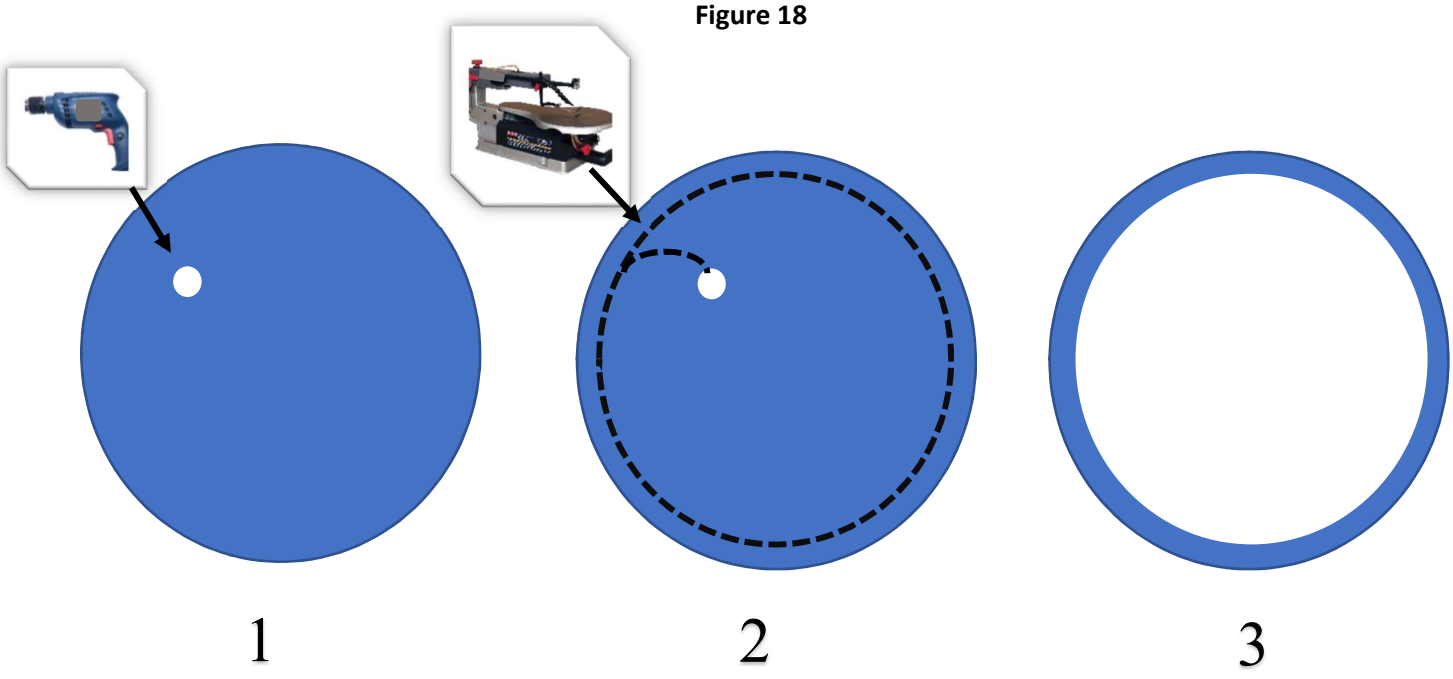


Figure 19

Final Assembly and Wiring

Wiring the Throttle Button

To wire the throttle button, the original connector at the end of the button's wires was removed. The two wires were then pulled apart from each other several inches from the end. The original throttle switch located under the gas pedal was removed and the two leads connected to the switch severed. All four exposed wires were then stripped. Then, the two leads of the throttle button were twisted into the two leads originally off the pedal switch. The connections were made with two male and two female shielded connectors. The button's wires were routed as shown in the simplified Figure 19. The wires were made to run under the tray, into the PVC frame, and out through a small hole drilled in the bottom of the frame. Note that the whole drilled in the bottom of the frame is for convenience during wire routing and is not strictly necessary.

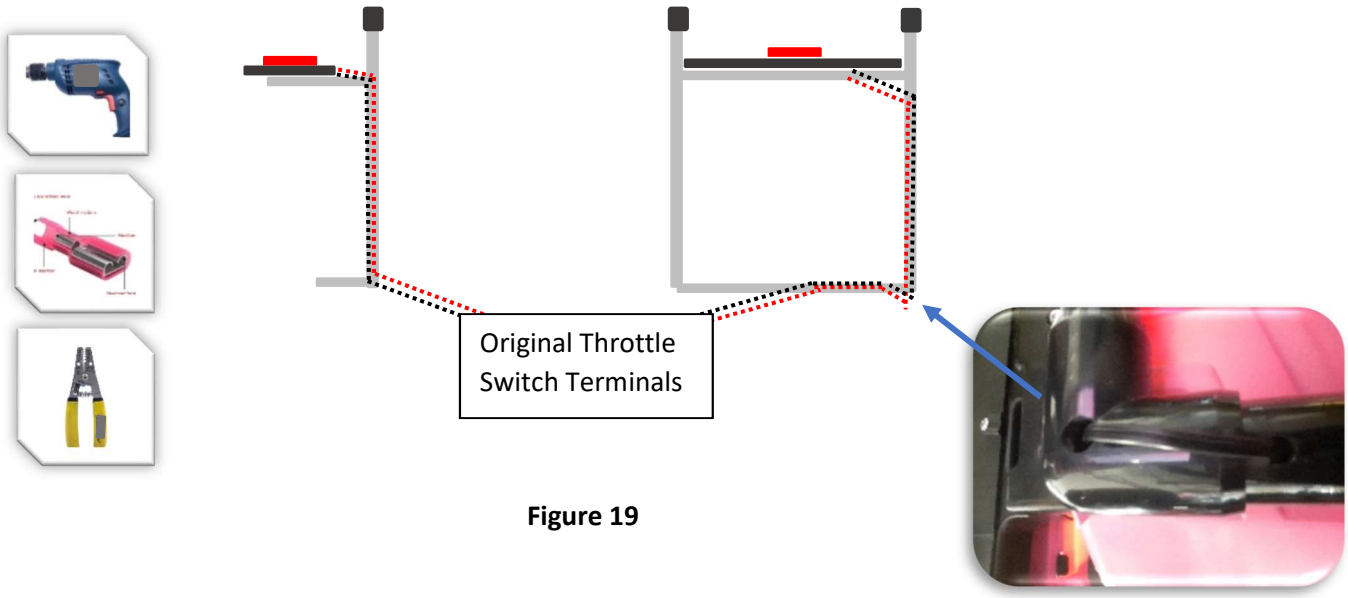


Figure 19

Mounting the Lighted Button

The finished lighted button was mounted to the tray using the three stock holes and three small sheet metal screws (Figure 20). For this build, a 3D printed brim for the button was mounted under the button (Figure 21). This brim is optional and serves to improve aesthetics and comfort for the driver. It is optimal to first drill pilot holes with a small bit through the brim (if used) and into the wood tray through the vinyl.

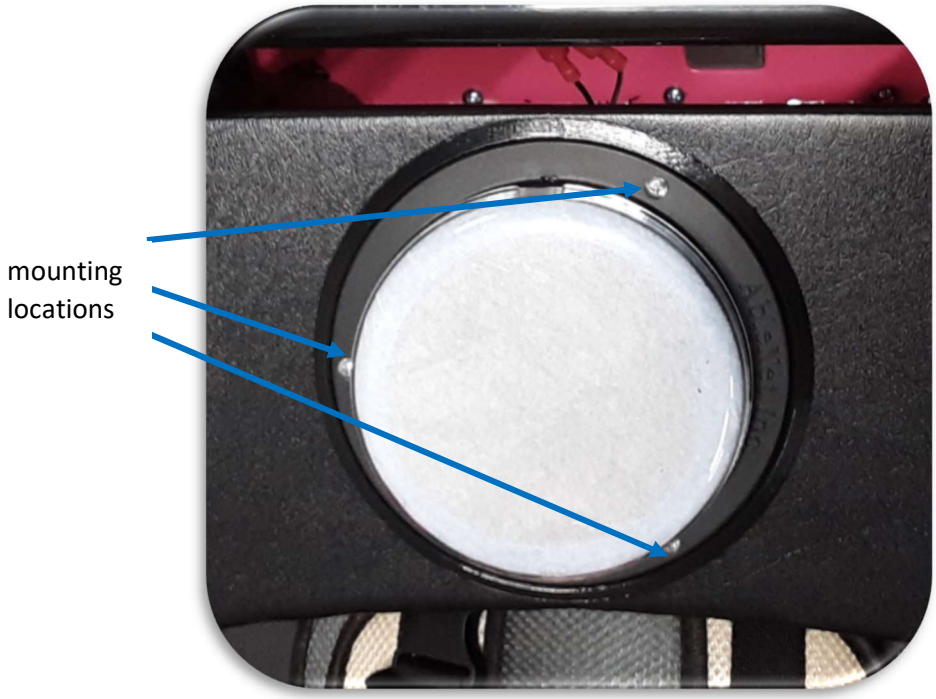


Figure 20

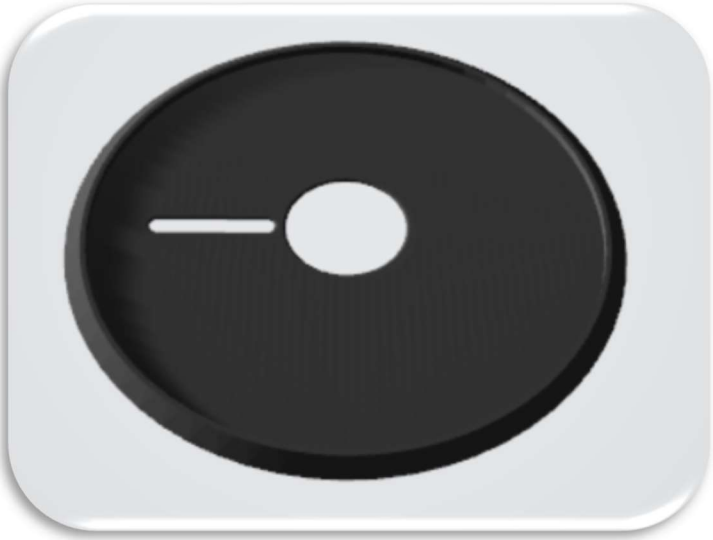


Figure 21

Mounting the Storage Bay

The storage bay was secured to the back of the car using the two mounting hooks described previously along with two belts mounted to the bottom of the bay and to the back of the car (Figure 22 and 23). The back of the seat was trimmed away to make room for the hooks and the original mounting slots for the seat were repurposed to accommodate the hooks using a razor blade. Then two size small synthetic leather belts were cut in two and the buckle sides mounted to the underside of the bay with two sheet metal screws so that the buckles rested just beneath the top of the PVC frame when fully stretched vertically. The other halves were mounted to the back of the car with two small bolts.

Figure 22

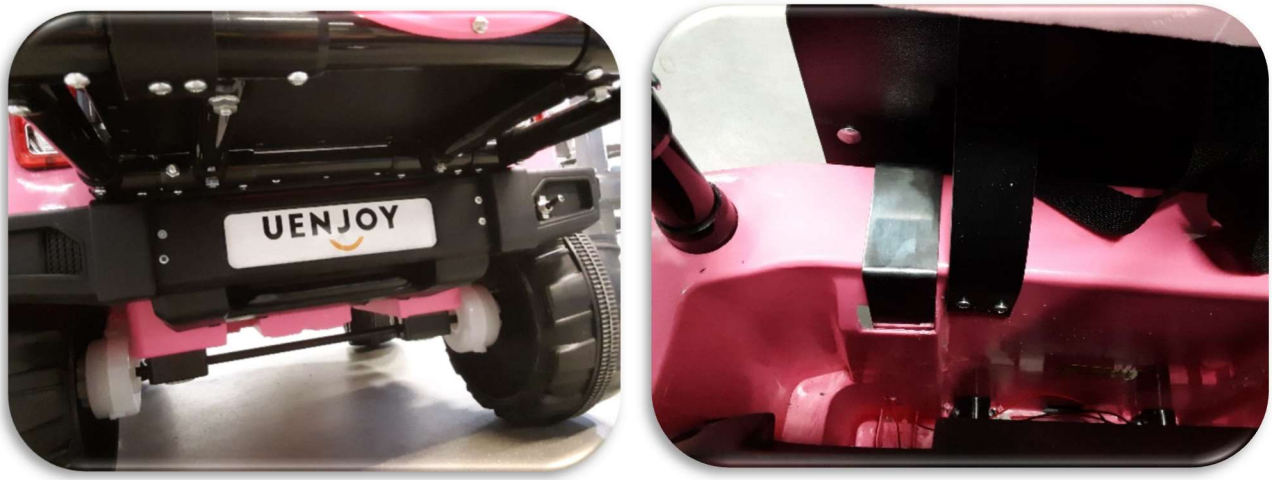


Figure 23

Securing the PVC Frames

All PVC components were secured using set screws at the joints (Figure 24). In this case, #8 3/8" pan head sheet metal screws were used. Before applying the screws, pilot holes must first be drilled with a small bit. Be sure the bit size is significantly smaller than the width of the threads on the screws. Then put the screws in with a standard screwdriver or a cordless drill with a Phillips head bit. Note that the two straps coming off the top of the harness are also mounted to the PVC roll bar with these same screws.

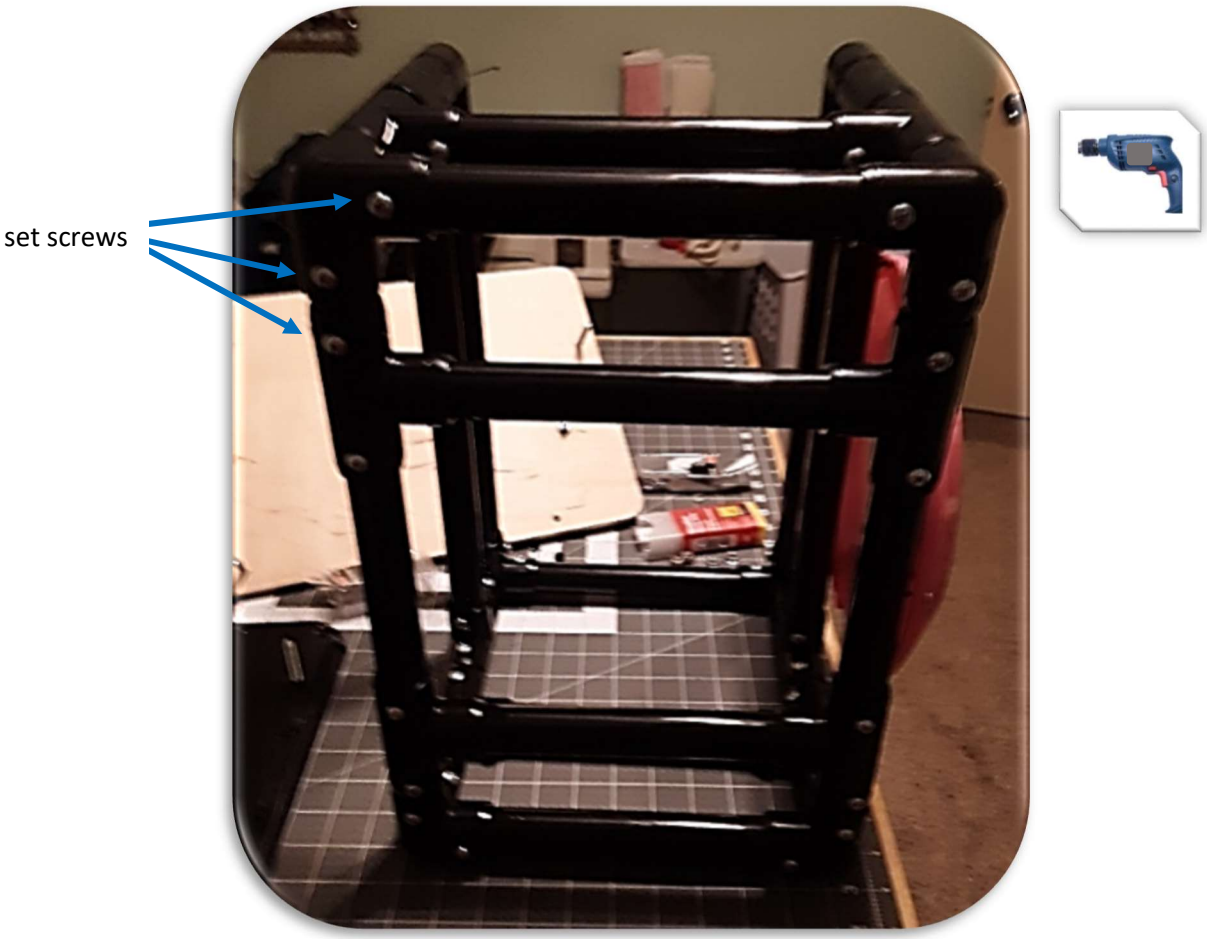


Figure 24

Securing the Seat

The next step is to secure the original seat. This was accomplished by replacing the stock plastic fasteners with more secure ¼" carriage bolts as shown in Figure 25. Some plastic covers underneath the car had to be temporarily removed before tightening the bolts on the underside of the car.

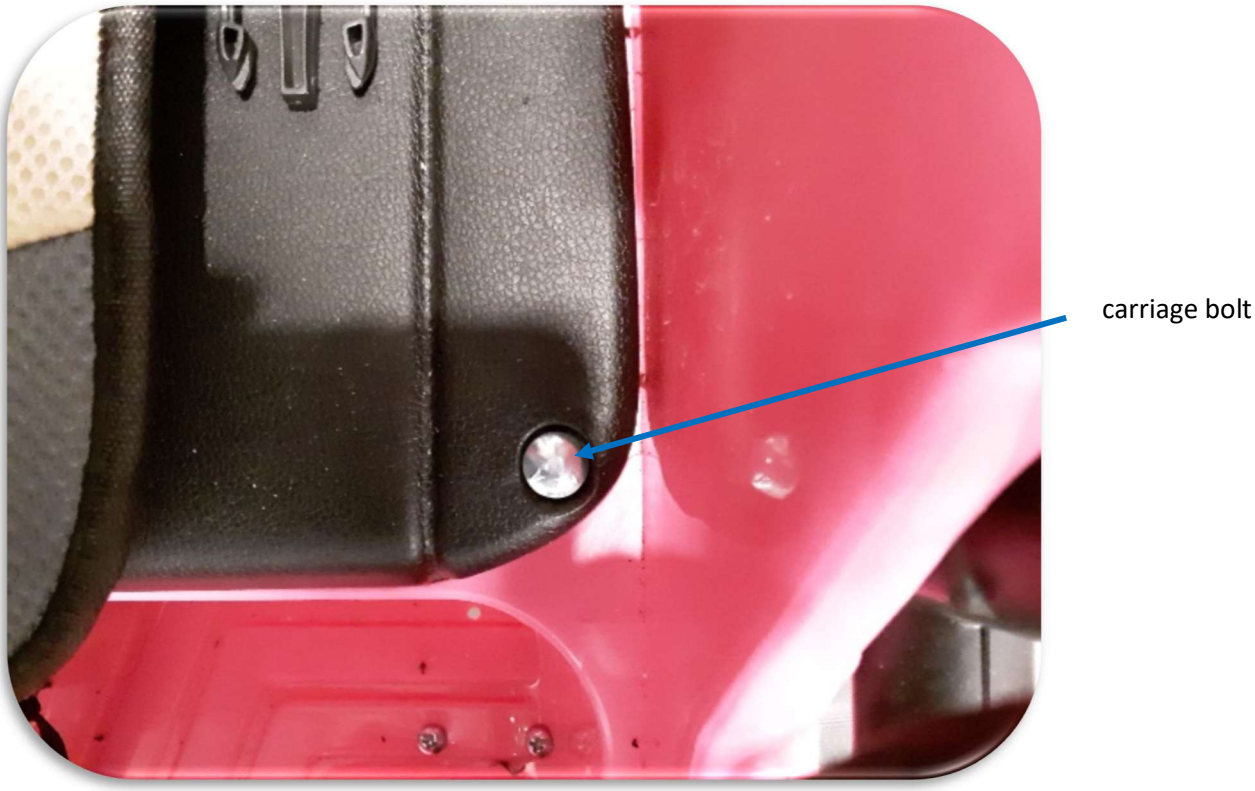


Figure 25

Reinforcing the Bumper

In order to comfortably support the additional weight of the storage bay, the hollow rear bumper was reinforced with two small sections of 1 x 4" boards. These supports were placed on either side of the car near the bottom as show in Figure 26. Any suitable wood saw can be used to cut the pieces into shape. Three wood screws were then used to secure them in place: two screws through the rear bumper and one through the motor compartment. The screws through the rear bumper were countersunk so that their heads were flush with the outside edge of the bumper.

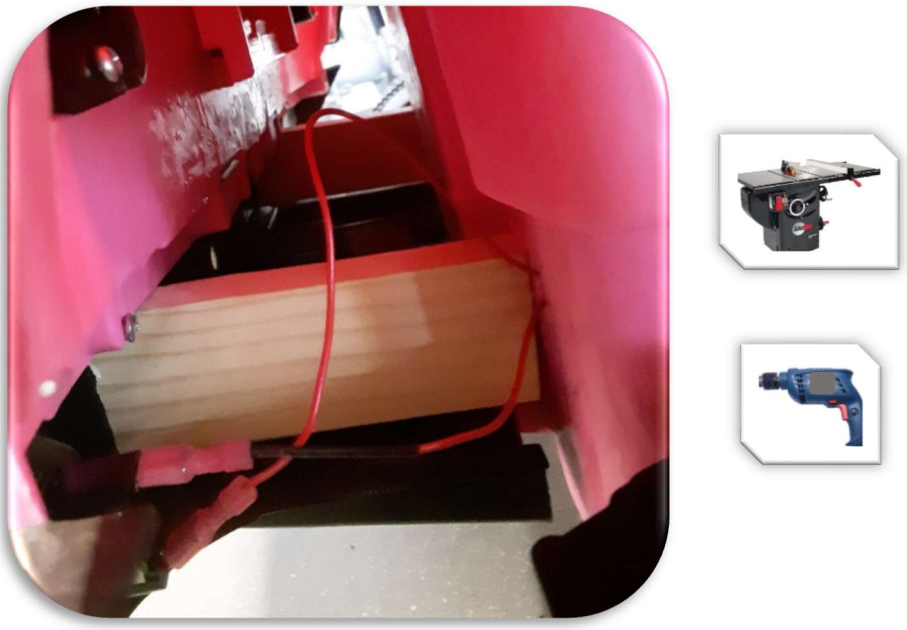


Figure 26

Aesthetic Features

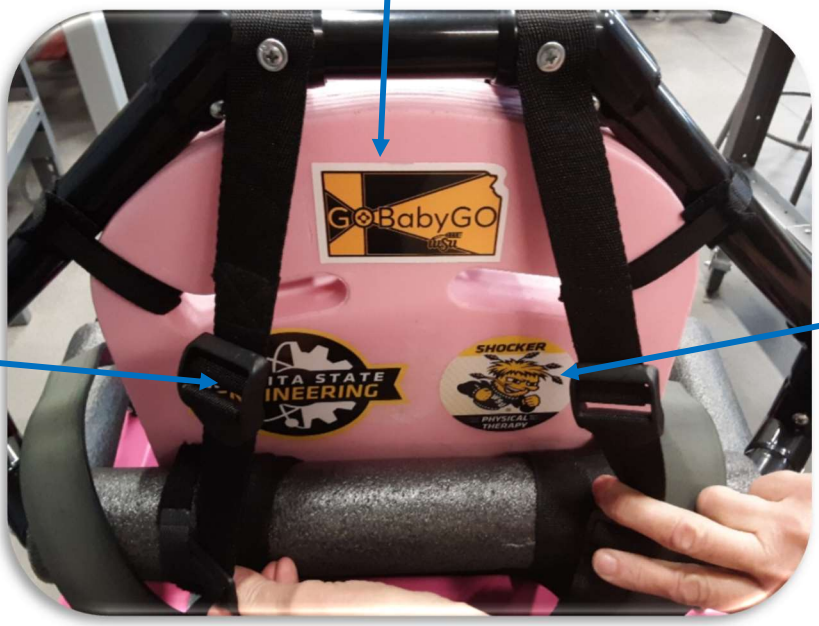
Black PVC pipe used for all construction

Stuffed monkey for Irasema

Custom “CHUNKEY MONKEY” decal

Custom ‘IRASEMA’ decal

WSU
GoBabyGo
sticker



WSU
Engineering
sticker

WSU
Physical
Therapy
sticker

Custom “GO IRASEMA GO!” decal

Delivery Day Notes/Observations

Successes

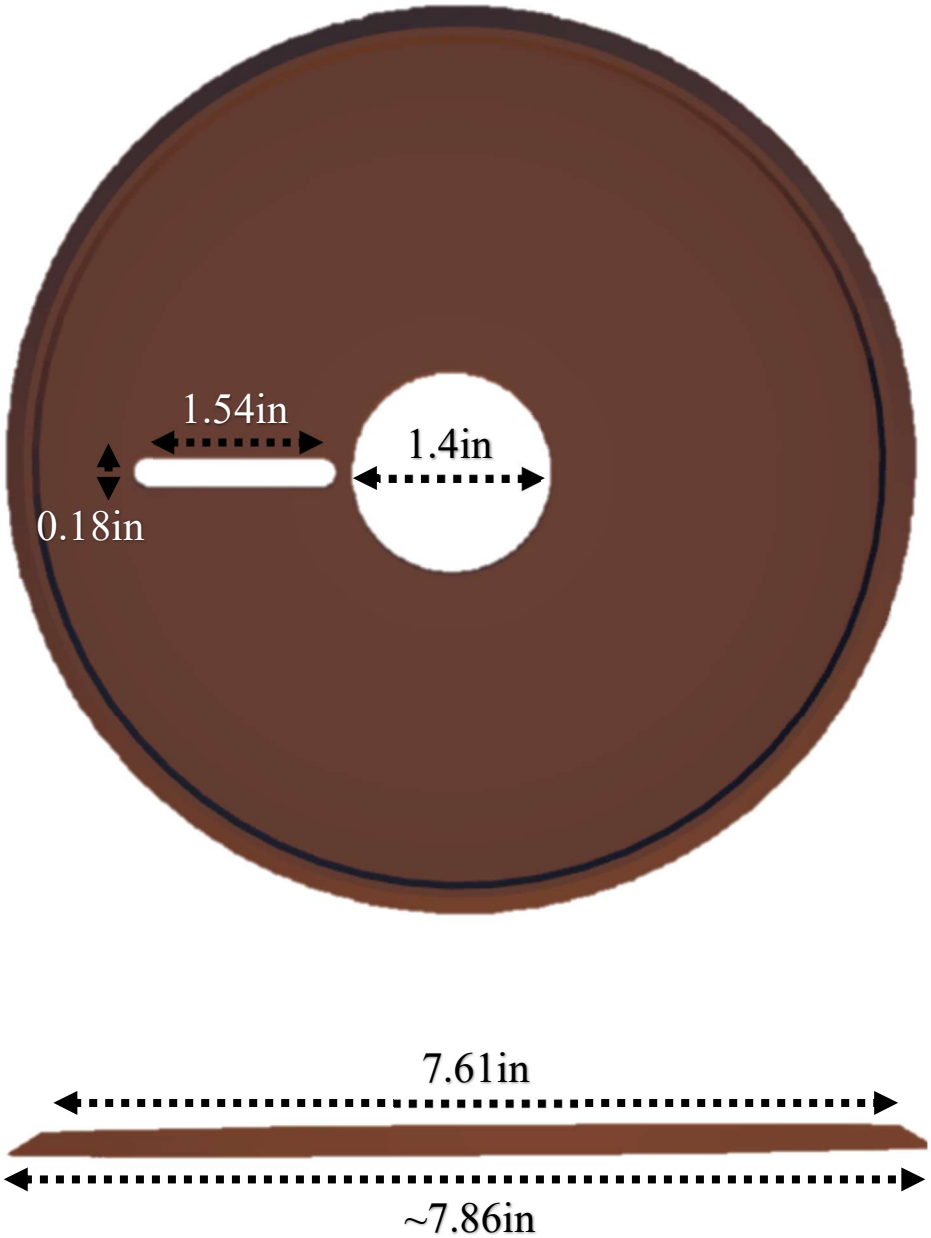
- The family was impressed with the overall appeal and build quality of the vehicle.
- Decals and the included stuffed monkey contributed significantly to the overall appeal.
- The ability to remove the storage bay easily was appreciated by the family.
- The internally lighted button was a great success with both the parents and Irasema appreciating its aesthetic.
- The radio control feature worked very well, allowing Irasema to control *when* she moves while her parents are able to control *where* she moves.

Criticisms

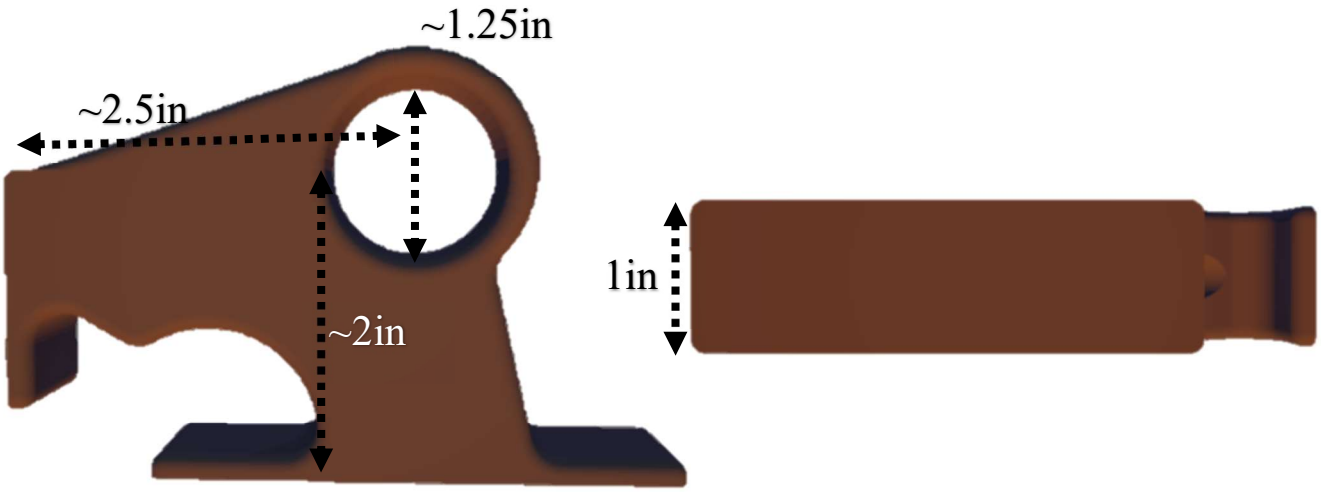
- The distance from the front of the tray table to Irasema's body was perfect in this case, but was measured conservatively and could have easily not fit. It is believed that having measured only Irasema's chest depth and not her abdomen depth as well contributed to this.
- A custom "owner's manual" for the car or an information sheet of some kind may have been useful for Irasema's parents.
- While the internally lighted button was a great success, the clear plastic cover was easily removed exposing the lights and button's internals. It is possible that Irasema could accidentally remove this cap herself and future builds should employ a more secure mounting system.

3D Printed Part Designs

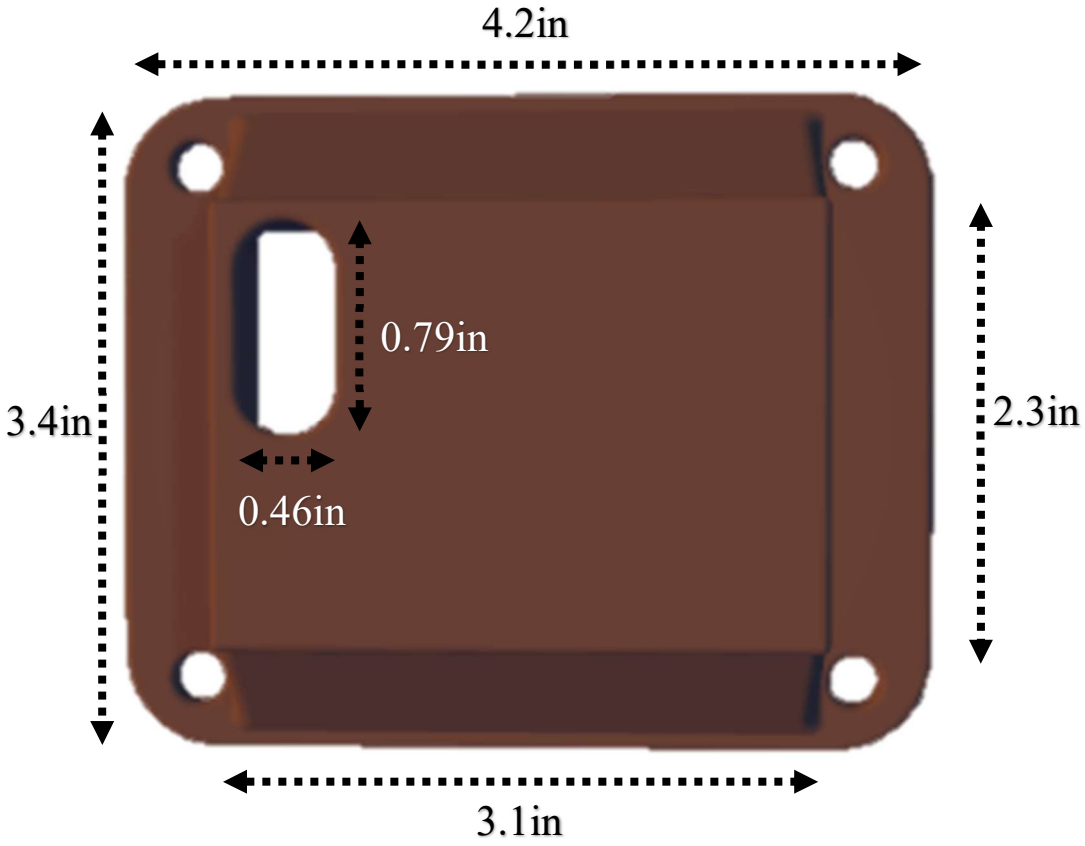
Button Ring

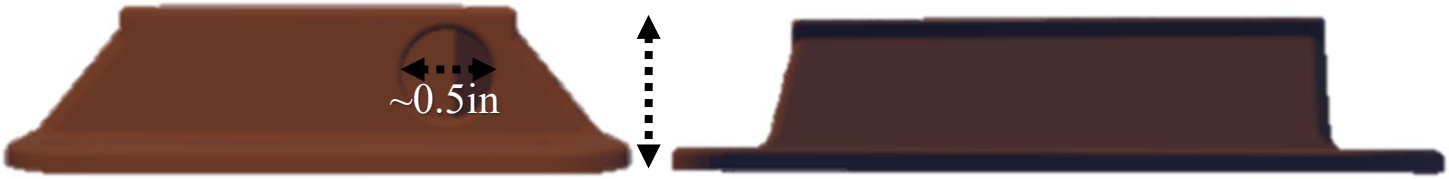


Tray Frame Brace



Battery Cover





0.86in (~0.75in internal depth)

Pictures with Tape Measure for Reference


CHUNKY
MONK