Mobile Tick Trap

Final Documentation

Team Ticked Off

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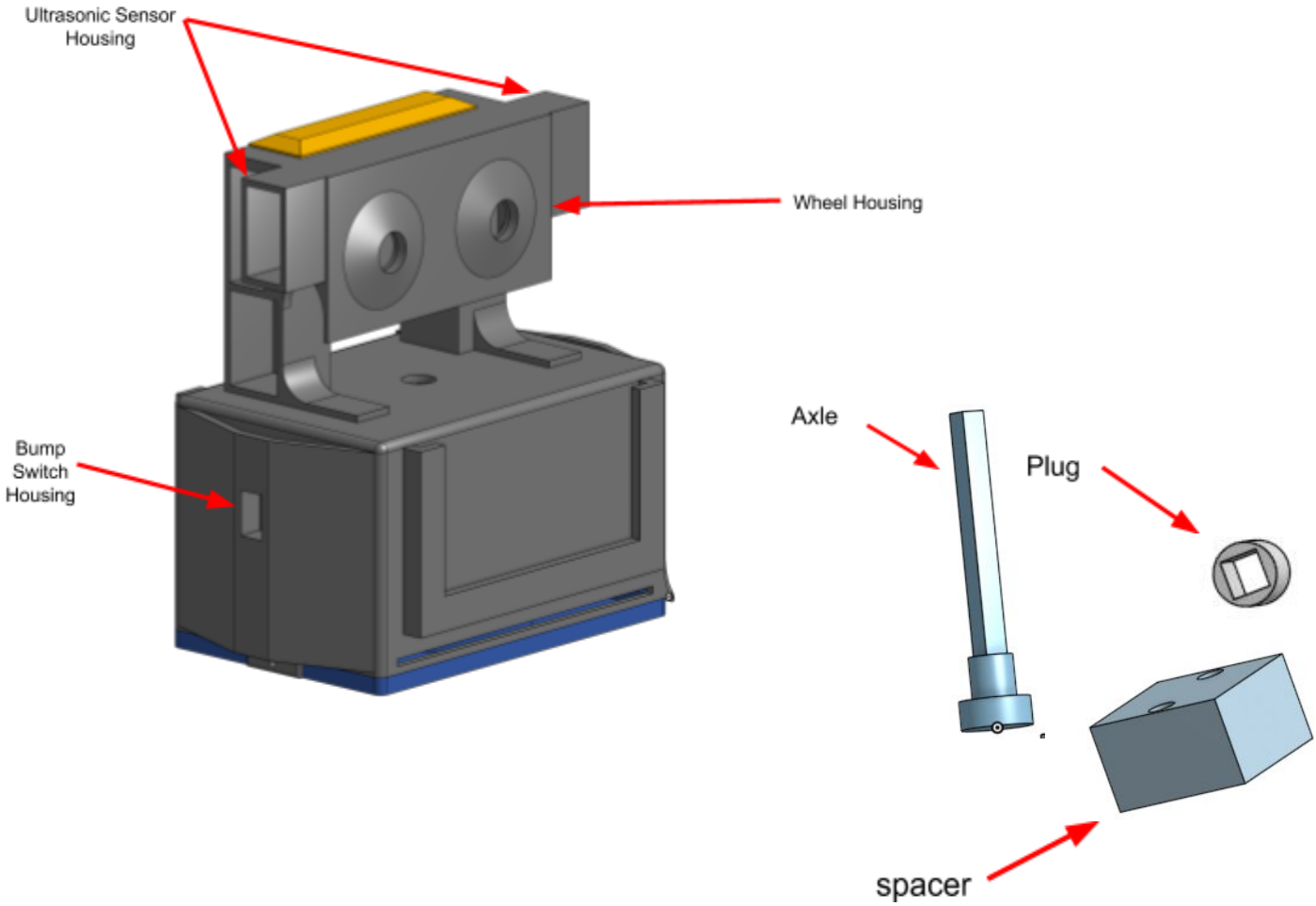
Engineering 151: Introductory Design and Computing

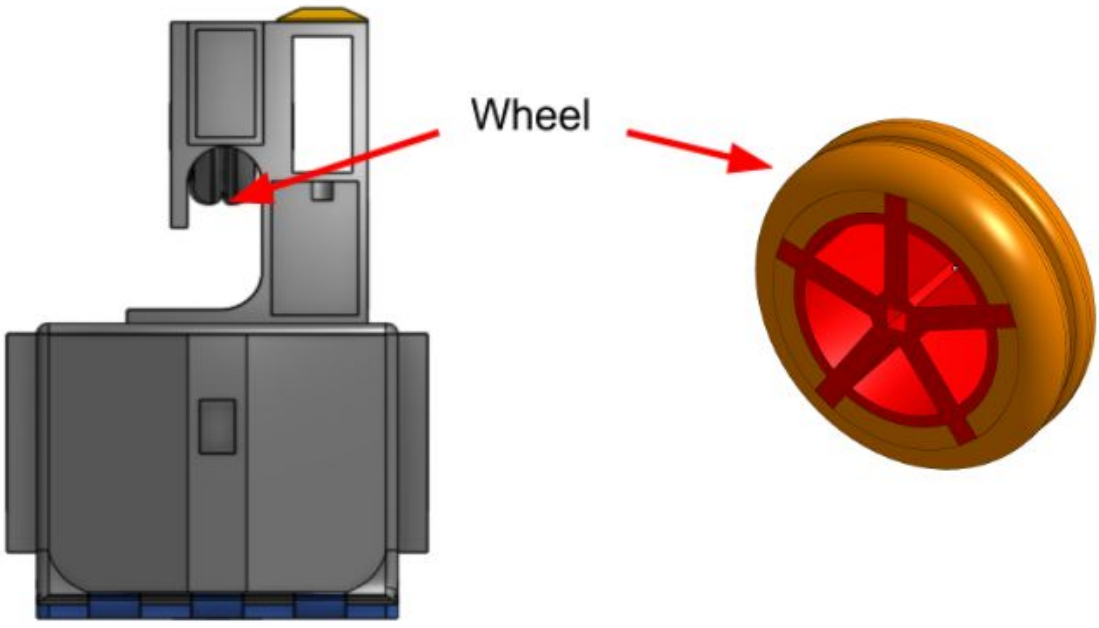
Design Description:

The Fixed Tether Trap design concept is designed to keep all the moving parts in one place. for this concept the tether is a 3/32 inch stainless steel cable attached to ratchet straps on each side pulling the cable taut. The trap would then have wheels mounted to the trap connected to motors that would drive the system. This system allows the length of the cable to be much more adjustable and easily replaced if necessary.

The two ultrasonic sensors on the trap are responsible for telling the trap to turn back when it reaches the end of the cable, or if an unexpected obstacle is encountered. The wheels are mounted on the wheel housing just above where the cable runs. On the front and back of the main body of the trap are two backup bump switches, these would help with ensuring the trap turns around if it were to come in contact with an object that was not detected by the ultrasonic sensors.

Having all of the motors and sensors on the main trap body has multiple benefits. There would only need to be one power source and all the technology together makes it easier to weatherproof.

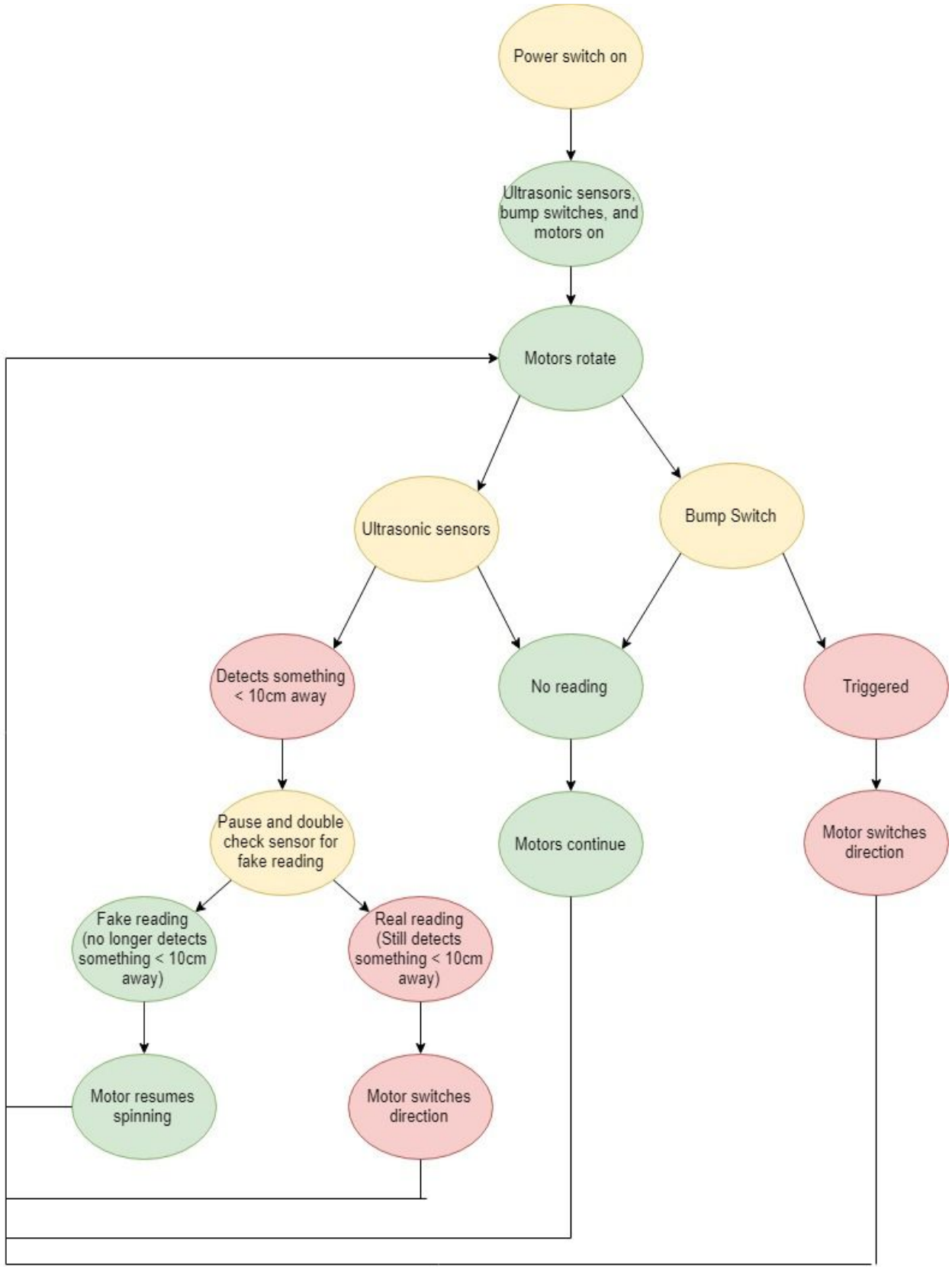




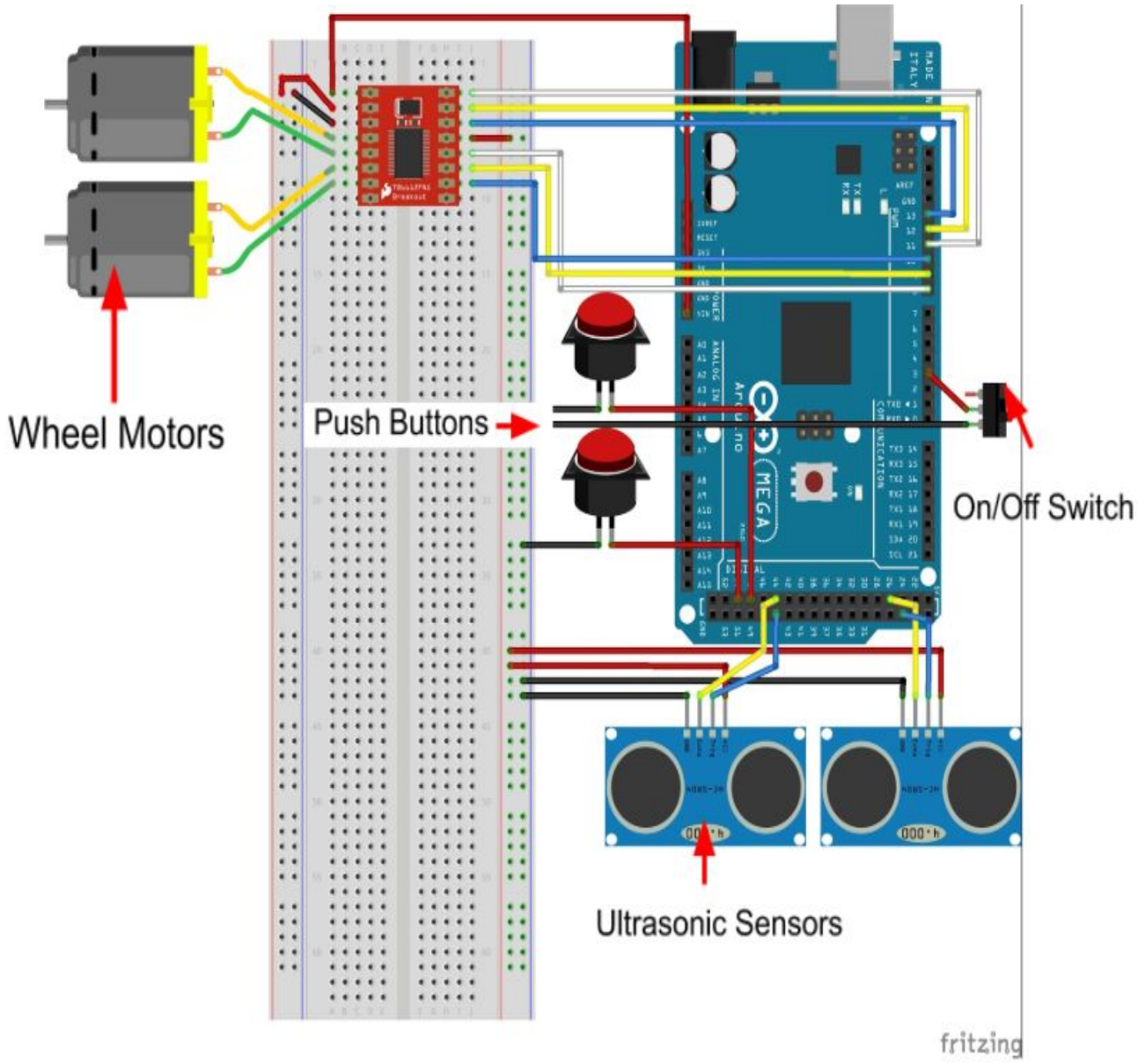
Complete Parts List

Part/Component Name	Description	Vendor (URL)	QTY	Unit Price	Total
Micro Gearmotor	Motor to drive trap	https://www.sparkfun.com/products/12285	2	$12.95	$25.90
Gearmotor Enclosure	Protect the motors, motor housing	https://www.sparkfun.com/products/12105	2	$1.50	$3.00
Ultrasonic sensor	Distance sensor, detects end points of the range	Will's Magic Box of Toys	2	$3.95	$7.90
Bump switch	Serves as failsafe in case sensors do not work properly	Will's Magic Box of Toys	2	$1.25	$2.5
Steel cable	3/32 in, stainless; lifts the trap off the ground	http://www.hardwaresales.com/catalog/product/view/id/5405/s/g332100c-250-feet-osha-asme-galvanized-wire-rope-3-32-inch/category/1267	17 ft	$0.39/ft	$6.63
PLA	3D printer filament; primary materials to print parts	Will's Magic Box of Toys			
Ratchet straps	Strap with ratchet crank; locks the two ends of the cable to two points	https://www.amazon.com/dp/B01AIWGB4I/ref=sspa_dk_detail_4?psc=1&pd_rd_i=B01AIWGB4I&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUFXTiY4NiOxNEpZUzUmZW5jcnlwdGVkSWO9OTAwODU1NzUyTFBFSzc0MExFVkdOJmVuY3JfcHRlZEFkSWO9OTEwMDg5MzUxODOwO1FBRkJaOTY1JndpZGdldE5hbWU9c3BfZGV0YWlsX3RoZW1hdGljJmFidGlvbi1ibGljaJJlZGlvZWN0JmRvTm90TG9nO2xpY2s9dHJ1ZO==	1	$11.95	$11.95
U-bolt	2 ended bolt in U-shape	Hardware sales	2	$0.73	$1.46
Bearings	For the wheels; supports the rotation of the wheels	Will's Magic Box of Toys	6	$0.10	$0.60
Slide switch	Serves as the power switch of the trap	Will's Magic Box of Toys	1	$1.50	$1.50
Velcro	Holds mop	Will's Magic Box of Toys	2 ft	$3.09	$3.09
				TOTAL COST (after tax)	$64.53

Flow chart of the code:



Wiring Diagram:

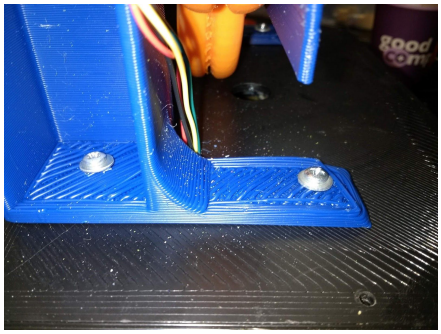


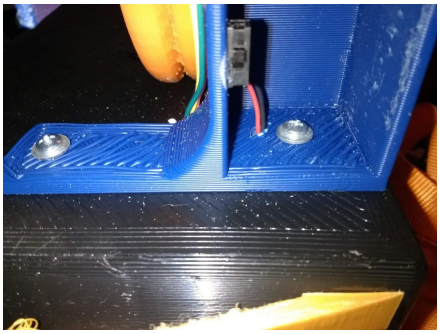
Onshape CAD File:

[Tick Trap with Wheel Housing Assembly](#) - This file contains all elements of the design. There are tabs at the bottom of the page for the constituent parts, including drive shaft and wheels.

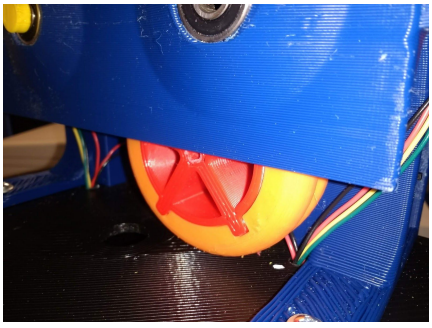
Assembly instructions:

*Step 1:*Bolt mount wheel housing on top of tick trap:

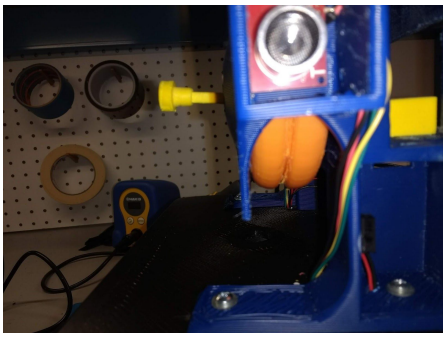


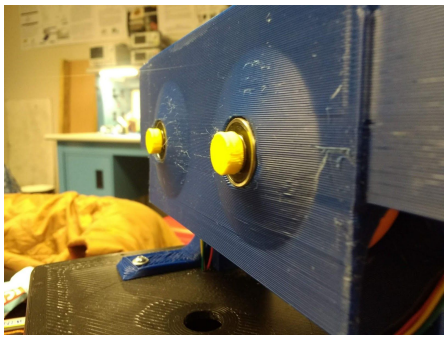


Step 2: Insert wheels into wheel housing:



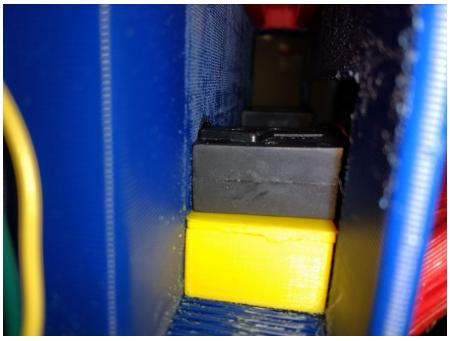
Step 3: Insert axle into wheel and press fit into bearing:





Step 4: Press plug into bearing inside housing:

Step 5: Insert motor into axle



Installation Instructions:

Step 1: Find two trees within a suitable distance (max 14 feet apart)

Step 2: Wrap ratchet straps around first tree

Step 3: Pull strap through center hole in ratchet

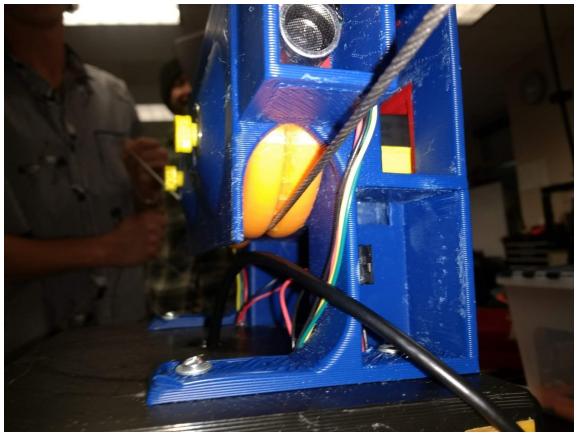
Step 4: Connect strap hooks from either end of the strap, snug strap up to tree.

Step 5: Ratchet snuggly to tree

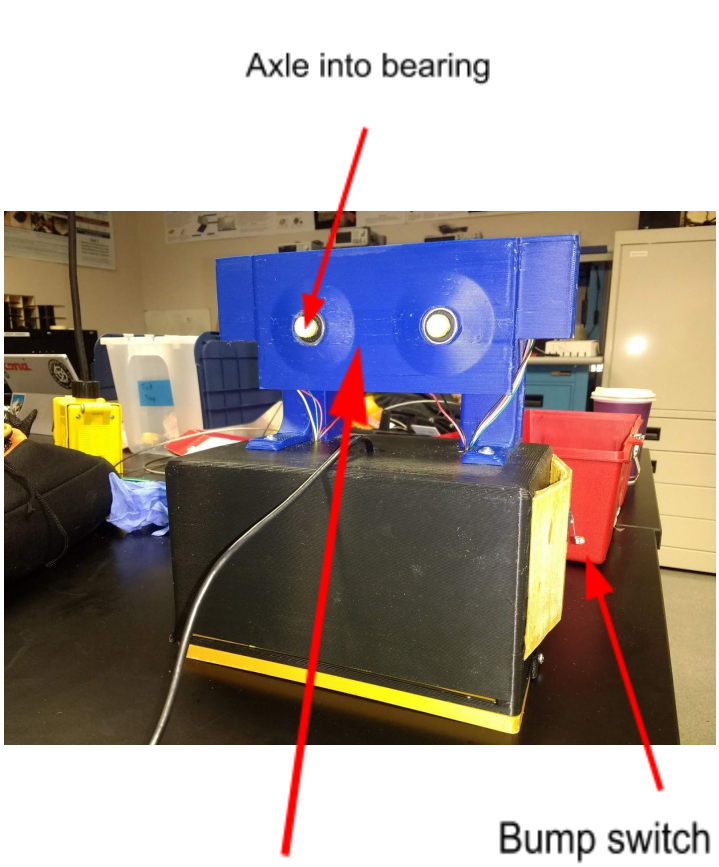
Step 6: Attach cable loop to strap hooks

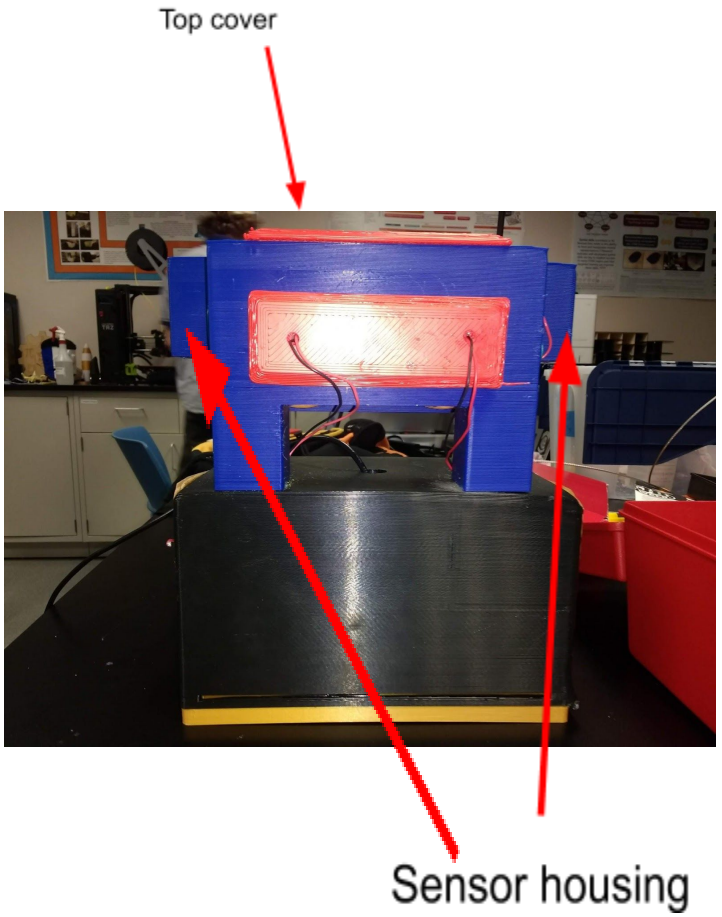
Step 7: Attach second strap and tighten slack out of steel cable

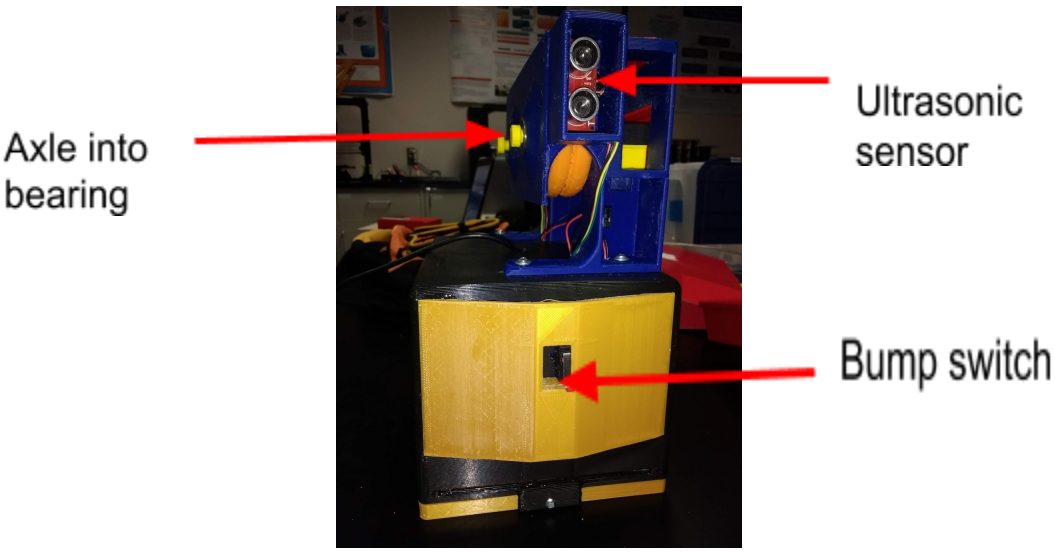
Step 8: Place trap on cable

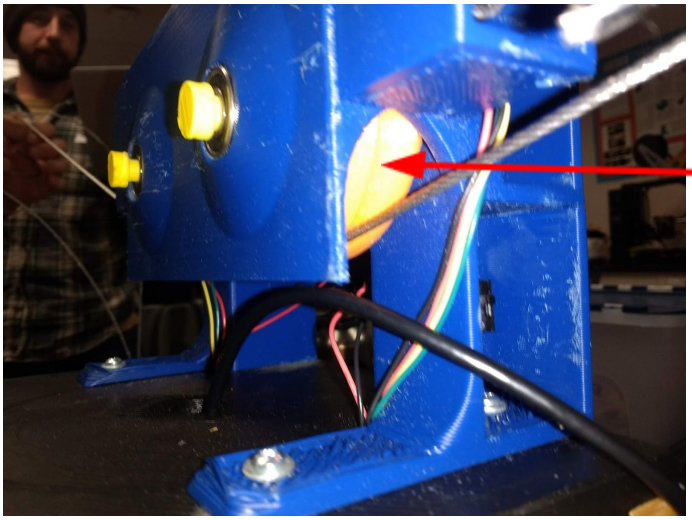


Final Project:

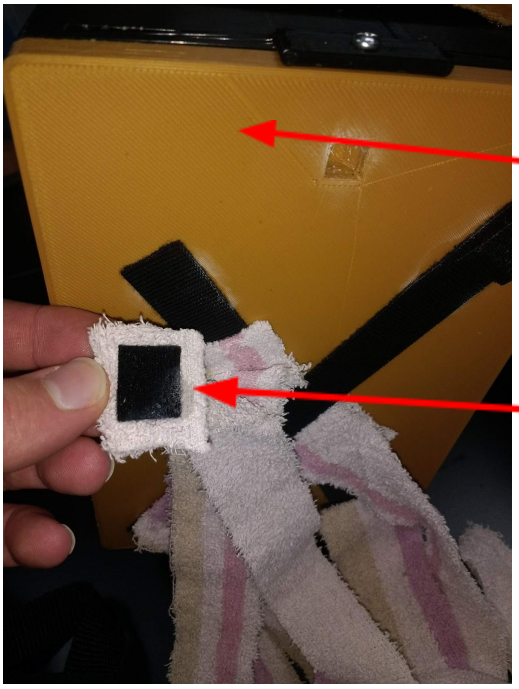






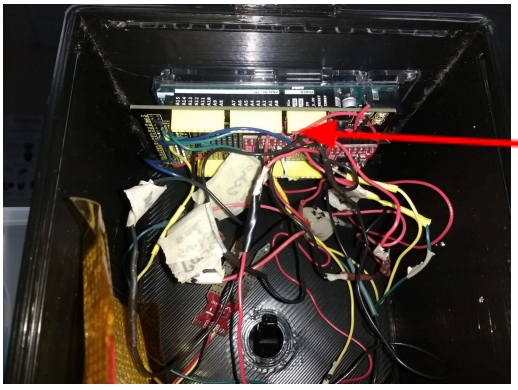


Wheel



Bottom of
the trap

Mops attached to
velcro



Microcontroller of the
mobile system

Testing procedures:

Rotation testing:

We need to test if the motors work. Put the trap on the cable and turn on the trap using the on/off switch. If the wheels (controlled by the motors) rotate and enable the trap to walk on the cable, the motors work. Otherwise, the motors do not work and need replacing.

Reaction testing:

We can test if the ultrasonic sensor works. Let the trap move over a short distance, then place an obstacle in front of one sensor of the trap. If the trap stops for a second and then changes the moving direction, the sensor works. Otherwise, the sensor does not work properly and needs replacing. To test the other sensor, we use the same testing technique.

Testing bump switches is also important. To test one bump switch, let the motors rotate in one direction for a while, then we push the bump switch, and hold for 1 second. If the motors stop for a second and change direction of rotation, the bump switch work perfectly. Otherwise, the bump switch fails to work and needs replacing. To test the other bump switch, we use the same testing technique.

Prototype Demonstration:

During our final prototype demonstration we found out that one of our motors had been damaged. It must have been dropped at some point. So for our demonstration, the trap wasn't as mobile as we would've liked. It did move and we did get the sensors to affect the motors during our demonstration. Because of the one motor not really wanting to work and because it was still connected to the wheel, it hindered mobility a little during the test. We also ran into the problem that the connection between the working motor and the shaft

Recommendations for future work:

There is a lot of friction between the wheels, they should be reprinted but slightly smaller. At least the outer orange parts need to be smaller. Also one of the motors broke and needs to be replaced, since it is stopped one of the wheels is frozen due to the motor being glued to the axle. Also gears should be added to drive the wheels, I would recommend a "worm gear", one large gear driving the wheel, and a screw gear that connects to it vertically.

Our model also relies on the connection between Arduino and laptop. We would recommend the next group make the mobile tick trap that functions without this connection. To successfully do so, the next group should also integrate a power source to the model so that it can last for a long time.

Another complication we haven't gotten the chance to improve is the CO_2 capacity of the trap. Currently, due to the small CO_2 cartridge, the trap can only release the gas for 24 hours, which would inconveniently require users to replace the CO_2 source everyday. It would be great if we could increase the CO_2 cartridge's capacity so that it could release the gas for a whole week before being replaced, this way the trap could be left in a remote location without anybody checking on it. Since the trap design changed from a stationary ground based model to a suspended mobile one, the "lid" to access the trap could be redesigned to minimize weight, and allow more tick access from underneath. The CO2 system is not currently integrated with the motor control system. Both the wiring and the code need to be connected and tested together.

Integration between the mobility and the trap would be an important step in moving forward. Currently the code and wiring of the mobile elements (ultrasonic sensors, push buttons on/off switch, motors) are independent of the tick trap elements (CO2, heating pad, moisture sensor).