Ve.R.O.N.I.C.A (Vermiform, Remotely Operated, Novel, Inductively Charged Apparatus) - Miniature Robot

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Need Statement

Problem:
We would like to address the need for a means of remotely accessing hard to reach, or dangerous locations.

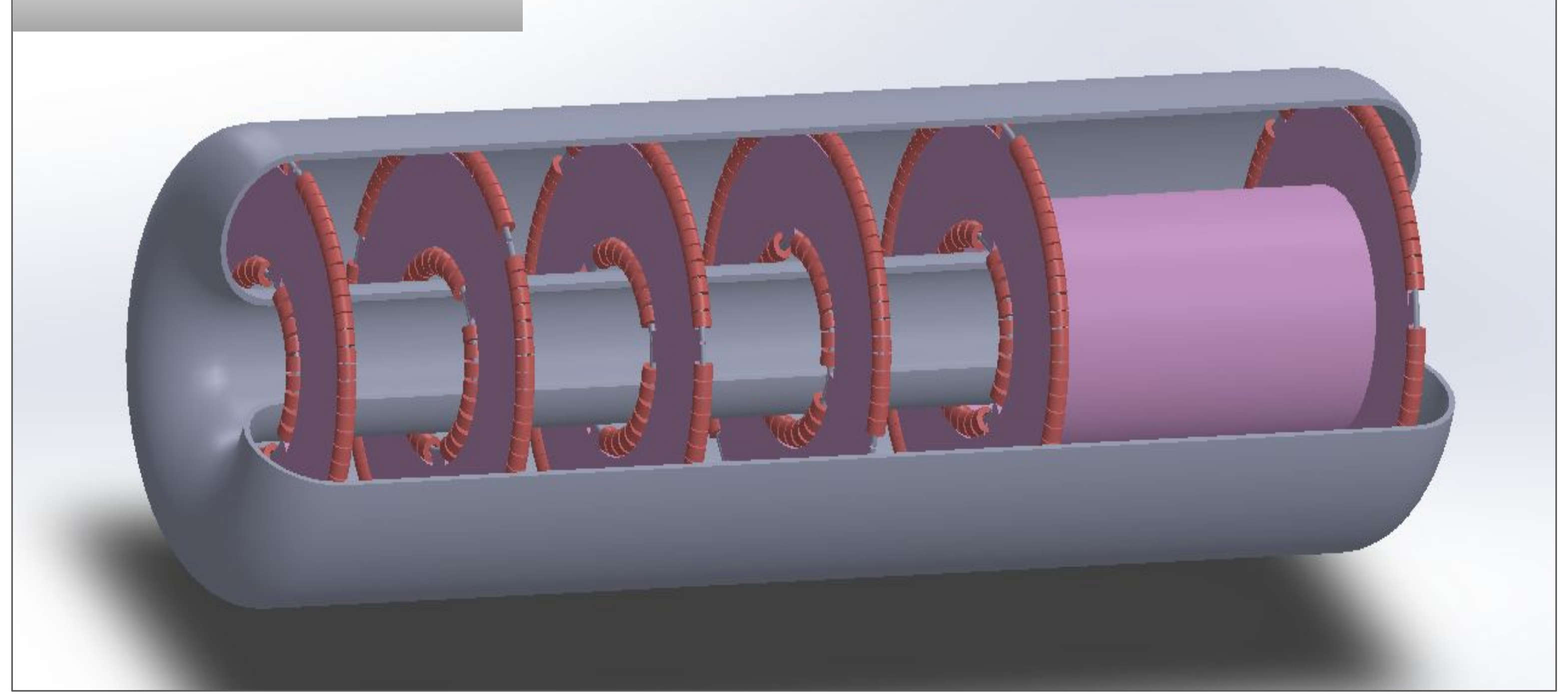
Population:
Navigate into areas where humans cannot go, and can withstand and navigate semi-sharp and rough obstacles.

Outcome:
An autonomous robot that is waterproof, safer, more cost efficient, and more practical for small spaces being searched or explored.

A small flexible robot, with the maneuverability and slenderness to be able to fit in tight spots, and deliver small amounts of food or medicine. Equipped with a camera, or some ability to send a message back to the user. Waterproofing is a must, with high manuverability on land and in water

Design Objectives

Basic 3D CAD Model

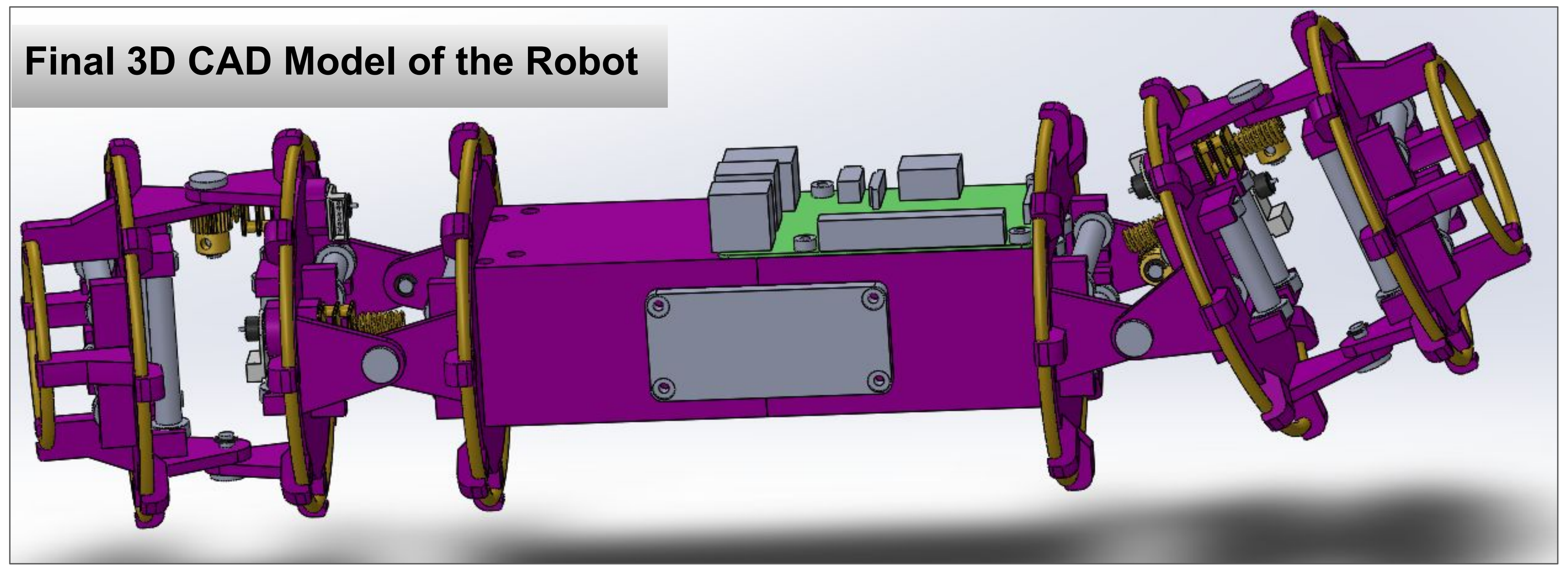


A very basic idea for a fully enclosed robot, was to use its own skin as the method of its movement. It would have a jointed internal structure with rollers so the skin could easily glide around the structure while keeping the internals clear and clean from water and any debris.

- Remote operation
- Water proof/resistant
- Dust proof/resistant
- Amphibious
- Inductive charging
- Approximate 1 hour run time
- Low cost
- Small/Light
- Onboard sensors (Video, audio, thermal etc.)
- Able to navigate rough terrain

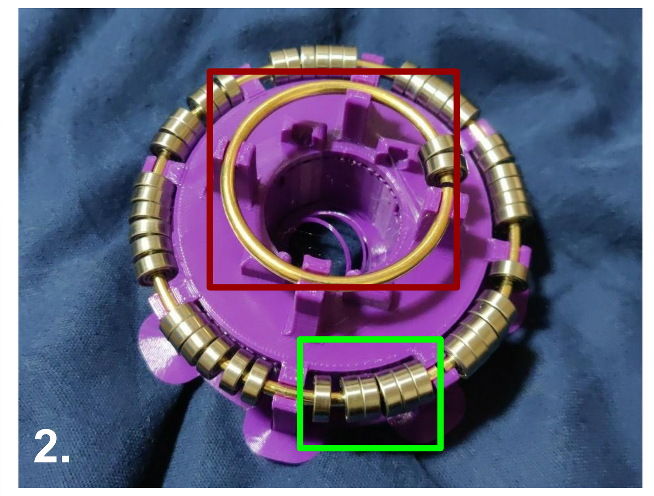
Built Device

Final 3D CAD Model of the Robot



1.

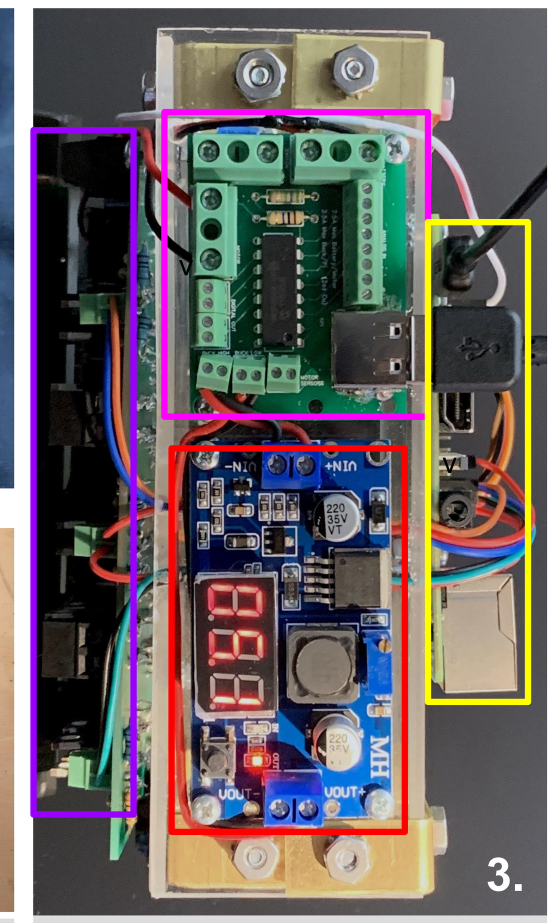
- Main Body Sections
- Individual Body Segment
- Roller Shaft Bearings



2.

1.

- Roller Bearings
- Brass Rings (to hold bearings)



3.

- Power Distribution
- Buck Converter
- Motor Controller
- On board Raspberry Pi

1. The prototype's main body, individual segments, and rollers/bearings were made through 3D-Printing, using PLA plastic. This material would be strong enough to create and test the prototype and could later on be adjusted or changed to make a stronger design.
2. All roller bearings sit on either 2'' (front and back) or 4'' diameter brass rings. Initially, the roller bearings were planned to be carbon steel deep groove ball bearing, however due to ordering and cost constraints 3D-Printed alternatives were instead substituted.
3. Electronic components were assembled around the rectangular main body on each of the 4 open sides. These components assembled on a test body with exact dimensions as the main body for testing purposes.

Acknowledgement

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- **Bill Anderson, PhD**

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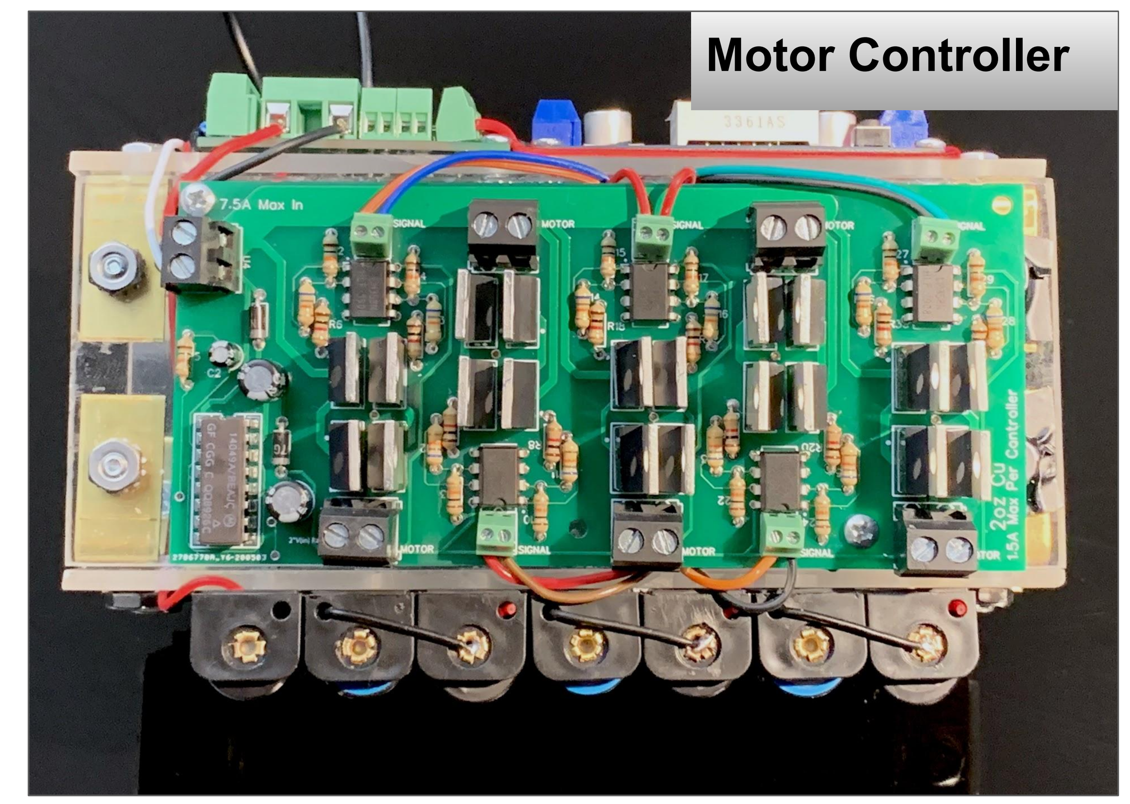
Testing

Clip bore diameter (inches)	Clip opening width (inches)
0.14	0.12
0.142	0.13
<u>**0.147**</u>	<u>**0.135**</u>

- The only form of repeatable testing for the project came from sizing different components.
- For example, the table on the left shows various sizes we tested for our ring clips to ensure a secure fit. The results of which are the underlined values, as shown.

Experiment/Analysis

Motor Controller



Amperage of RPi + 1 motor

Amperage of RPi (isolated)

- The combined maximum draw of all six N20 motors and the Raspberry Pi (RPi) controller was measured to be 2830 mA using an ammeter. 1.2 volt batteries can provide 2800mAhr of energy and seven of them in series would create a potential of 8.4 volts. This a sufficient voltage to operate the N20 motors and the controller.
- Using this data, the device will have a theoretical minimum run time of 0.78 hours (approximately 47 minutes).

Conclusion & Future Work

- In conclusion we were able to construct the skeletal structure of the robot complete with articulating joints, working rollers and most of the key electronic components.
- Further work will need to incorporate the outer skin of the robot, which acts as the driving mechanism. Limited time and resources prevented us from properly testing these items.
- Many of the 3D printed items (drive rollers, roller guides, pulleys, skin rollers, and hinge pins) will need to be machined for the final product to ensure durability, strength, tolerance, and smoothness.
- The incorporation of a Graphical User Interface (GUI) and camera for the robot operator would make navigation and feature usability much more user friendly. It would also reduce the amount of training needed, and simplify controls.