One if by Land, Two if by Sea

Axolotls

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Abstract

The 2021 Seaperch In The Wild Amphibious ROV challenge is all about creating an ROV that can quickly and efficiently adapt to its surroundings as well as maintaining performance integrity in both land and water. This challenges competitors to think about the real world applications of their Seaperch builds, and challenged us to think beyond the water and find new ways to apply the knowledge this ROV build has given us. We conceptualized that an ROV of this purpose would be extremely practical for exploration of of wreckage or even environments not safe for humans such as radioactive fallout zones.

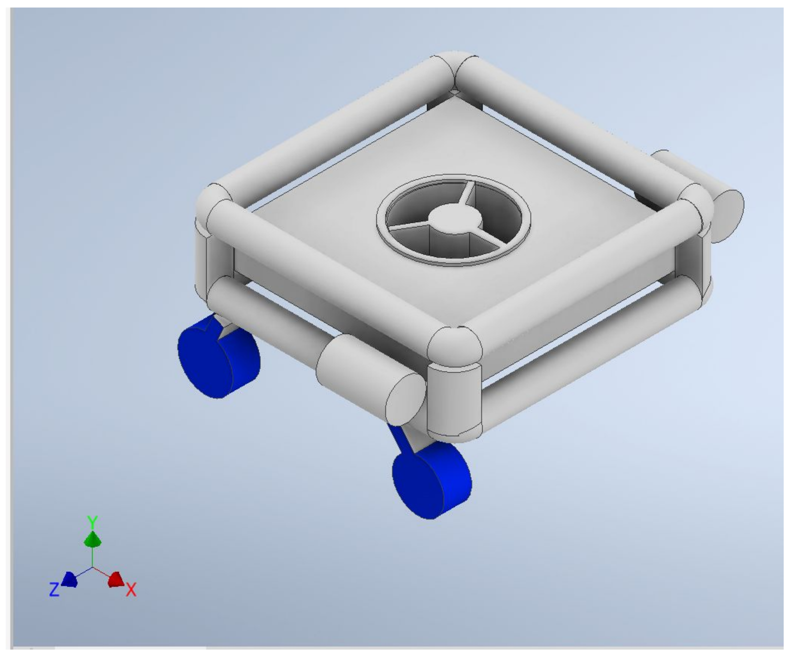
Background & Motivation

When conceptualizing our amphibious Seaperch, we first wanted to understand the application of amphibious ROVs so that we could better understand the needs of our ROV.

When brainstorming ideas, our most advanced idea utilized hub motors inside all-terrain RC truck wheels that would be housed parallel to our electronics bay. When activated, the four wheels would push out and rotate downwards, similar to the wheel system on the NASA Curiosity rover, until they reached solid ground to function as wheels. We would uses a servo and gear system to create the wheel deployment system, and the hub motors would be the active driving force once deployed. This ROV would switch from using the Seaperch motor thrusters to the hub motors once the wheels are engaged.

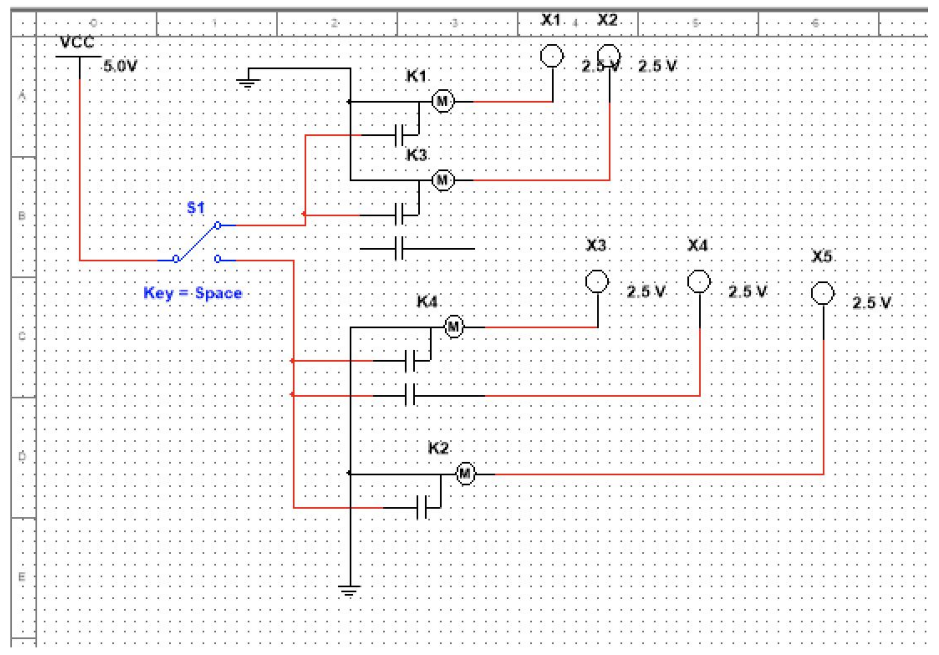
Methodology

After finding the purpose for the amphibious ROV that we wanted to pursue, and after evaluating our competitive ROV and seeing what we had the capability to do, we decided on elaborating on our tetherless ROV that is controlled via a microcontroller, transformer, and two motor controllers. We want to make our ROV amphibious for exploring areas that are difficult to navigate or not safe for humans. First, we decided to add 4 wheels to our ROV. The four wheels would be modified versions of wheels used for all-terrain RC trucks that house waterproof hub motors inside the wheel. Hub motors work by rotating the stator magnets and outer frame around a static armature assembly, which is the inverse of how conventional motors operate. When we wish to transform our drive system, we would press a custom button on our controller that sends a signal to our microcontroller to redirect power from the motor controllers used to control our aquatic Seaperch DC thrusters (P) to different motor controllers for the land-based drive assembly(D). These servos keep the driver motors stored flush with the frame of the ROV when power is to circuit P and when power is switched to circuit D a signal is sent via an if: then statement saying that if switch value = 1; then rotate servo X clicks. this statement allows the drive motors to be brought down Degrees to support the ROV and its navigation on land. The extended legs are highlighted in blue in the Autodesk Inventor Model Below.



Results & Discussion

When building up our circuit , we struggled the most with keeping our circuitry straight specifically for our power and grounds after alternating our power routes. We ultimately decided to have two different grounds. Another issue we found was physical space. In our original seaperch design, space was already tight but adding more electronics created a situation in which we could not seal our lid. We decided that in order for this idea to work, we would CNC mill a custom electronics bay out of cast acrylic measuring 8.5 x 9 x 1.5 inches in order to comfortably fit all of our necessary electronics. We also needed to re-evaluate our code; adding in extra statements as mentioned in the Methodology segment. We also added a recovery line, using an “if-then” statement, essentially stating that if signal=0; propel the ROV back to the origin based on the onboard navigation. This statement allows our ROV to move back into navigational territory if the signal were to be lost. Through the conceptualization of this ROV we learned the challenges of dual-process circuits and how to properly navigate them. One of the biggest tools we used was Multisim; an online circuitry software that allowed us to prototype our circuits and save evolutions of them as needed as pictured below in figure R-1.



R-1:
in this figure, the top circuit represents circuit D and the bottom circuit represents circuit P. The probes/ LEDS represent the outputs represented by the motors.

Conclusion

In a time where nuclear engineering is becoming increasingly more important, this ROV would prove effective by providing access to radioactive areas allowing us to better understand the effects of radiation. Applications of this ROV are not just limited to the nuclear field. The applications of this ROV are inspired by aerospace and would excell on uneven extraterrestrial surfaces. Other potential applications of this ROV include cave exploration and navigation, collapsed structure navigation, and military applications including explosive ordinances sensing and deactivation.

Next Steps

Continuing on with this project, we would like to add solar panels to the ROV, allowing it to run solely on clean energy. We would also like to create an emergency backup power source , ideally with capacitors, so that if our ROV were to lose power, the backup power source would bring the ROV back into range so that it could ping a GPS device.

Acknowledgements

How do brushless hub motors work? (2020, August 21). Retrieved May 04, 2021, from https://www.explainthatstuff.com/hubmotors.html

Wheels. (2019, August 20). Retrieved May 04, 2021, from https://mars.nasa.gov/msl/spacecraft/rover/wheels/