HackRover: Cyber Security in *Motion*

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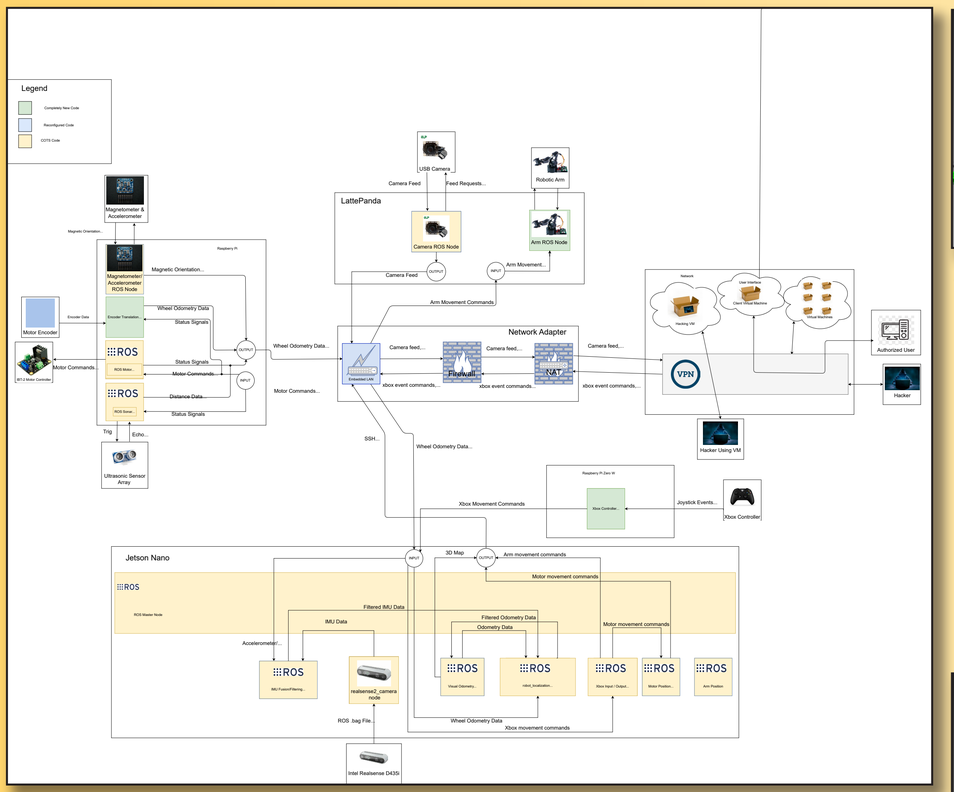
Why 4.0 INDUSTRY Solution

All technology-reliant companies are interested in leveraging big data to make better decisions about products and services. The way that industry is supporting the shift toward big data is by collecting diagnostics and other info in real time from sensors. This trend toward leveraging the Internet of Things is what many are calling “Industry 4.0.”

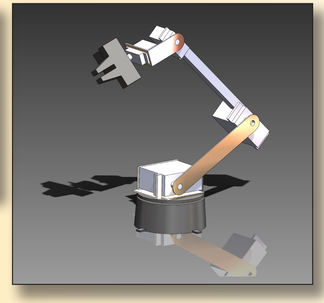
The aim of this capstone was to develop a model for exploring ethical hacking of self-driving cars and autonomous manufacturing equipment. This model would use technology similar to both, mainly through the use of embedded systems and sensors.



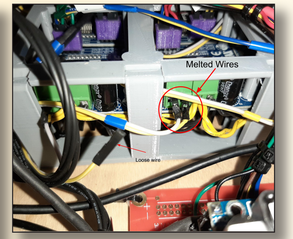
The system architecture for a semi-autonomous rover was laid out in a flowchart.

Data Analysis & Testing

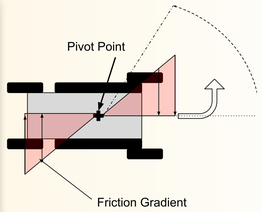
Root cause analysis was used to find the reason for permanent marring and bending in all of the drivetrain’s 6mm 2101 stainless steel shafts. 8mm carbon steel keyed shafts were used in the newest iteration for easy maintenance and greater dynamic loading capacity.

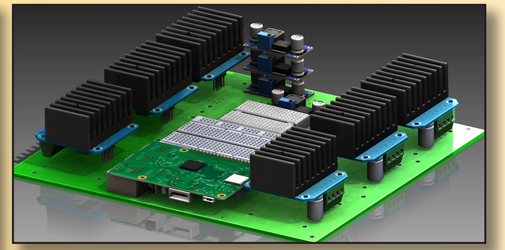


To facilitate remote software testing of the arm, a simplified model was made in SolidWorks with accurate link dimensions and weight distribution.

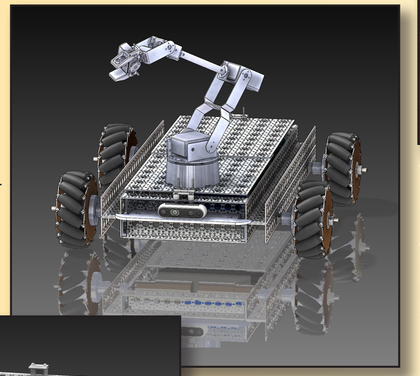


Motor power wires were burnt during a Winter demonstration. Investigation revealed that drivetrain motors were exceeding allowable current draw of their power wires while the rovers were driving on carpet. Wire sizes were increased from 22AWG to 16AWG.

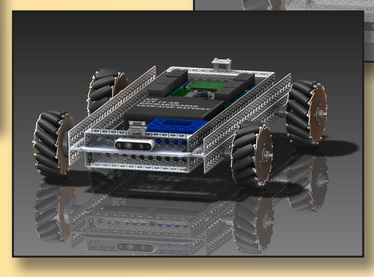




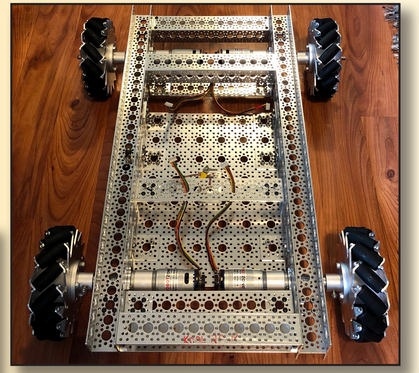
A printed circuit board was designed in collaboration with an Electrical Engineering capstone in order to enhance the integrity and repeatability of our rover’s electrical system.



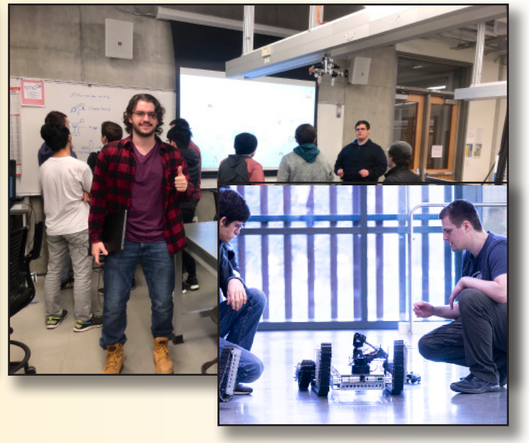
A mecanum wheel-based drivetrain was designed to better suit the mobility needs of an indoor rover.



Results



With the new frame built, the rover is ready for integration of electrical, mechanical, and software elements.



We have implemented drivetrain and arm controls with an Xbox controller. Follow our Github page to see the codebase and new feature projects:

The project sparked enough interest to start a HackRover club, the purpose of which is the same as this capstone project: to promote cyber awareness in IoT/IIoT. For more information, visit hackrover.com or email hackrover@gmail.com.

Conclusion & Future Work

The project still has not achieved autonomy, which is crucial for our hacking functions. In the next iteration of the project, the following topics should be explored:

1. ROS drivetrain control development
2. Simultaneous Localization and Mapping (SLAM)
3. One-shot learning for arm articulation tasks

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