FERMILAB-POSTER-23-189-STUDENT

Prototyping High Mobility Inspection Robot

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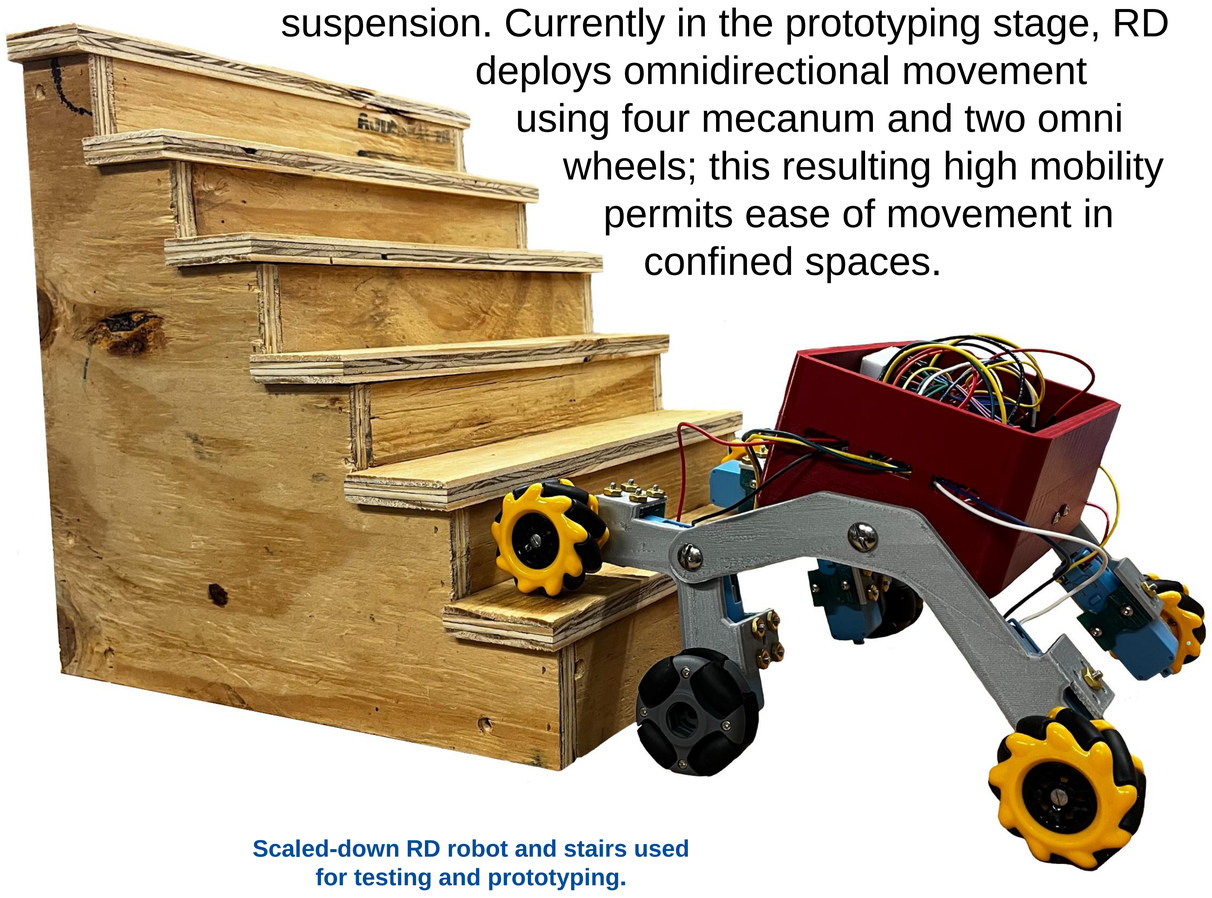
The Robot's Goal

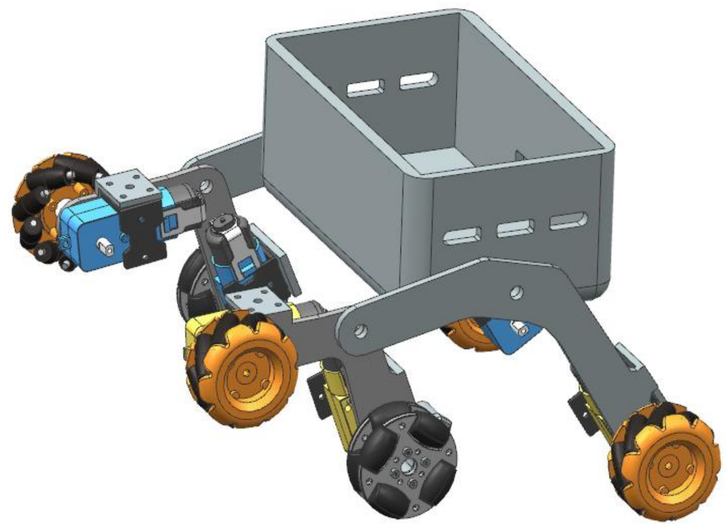
The AD Robotics Group specializes in developing robots to pinpoint sources of failure in the accelerator tunnels with the goal to reduce radiation dosage for personnel and optimzie beam delivery efficiency. The six-wheeled robot, nicknamed 'RD,' aims to be an accelerator tunnel reconnaissance robot capable of passively climbing obstacles such as stairs using a rocker-bogie suspension. Currently in the prototyping stage, RD deploys omnidirectional movement using four mecanum and two omni wheels; this resulting high mobility permits ease of movement in confined spaces.



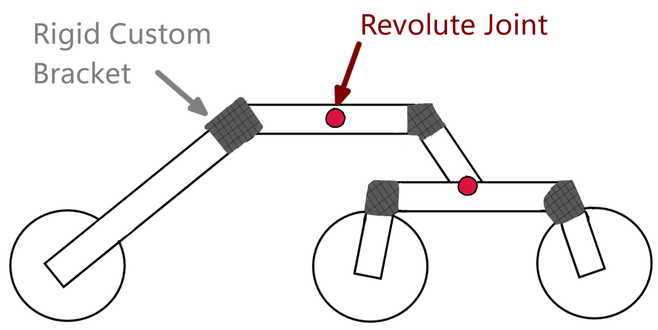
Scaled-down RD robot and stairs used for testing and prototyping.

Designing the Scaled-Down Prototype

The RD prototype is scaled down to test if the omnidirectional wheels provide enough friction to successfully climb stairs; this also permits cheaper and faster prototyping. The robot and model wooden stairs are a 1:4.23 reduced-scale prototype; this scale approximates the full-scale robot's planned 8-inch diameter wheels and obstacle of standard stairs. The resulting RD prototype stands 5.56-inches tall, 9-inches wide, and 9.5-inches long. The scaled-down RD's rocker and bogie linkages, chassis, and motor mounts are 3D printed in PLA to allow for rapid prototyping and quick quick changes. All electrical connections contained within the chassis and mounted with custom 3D-printed stand-offs.



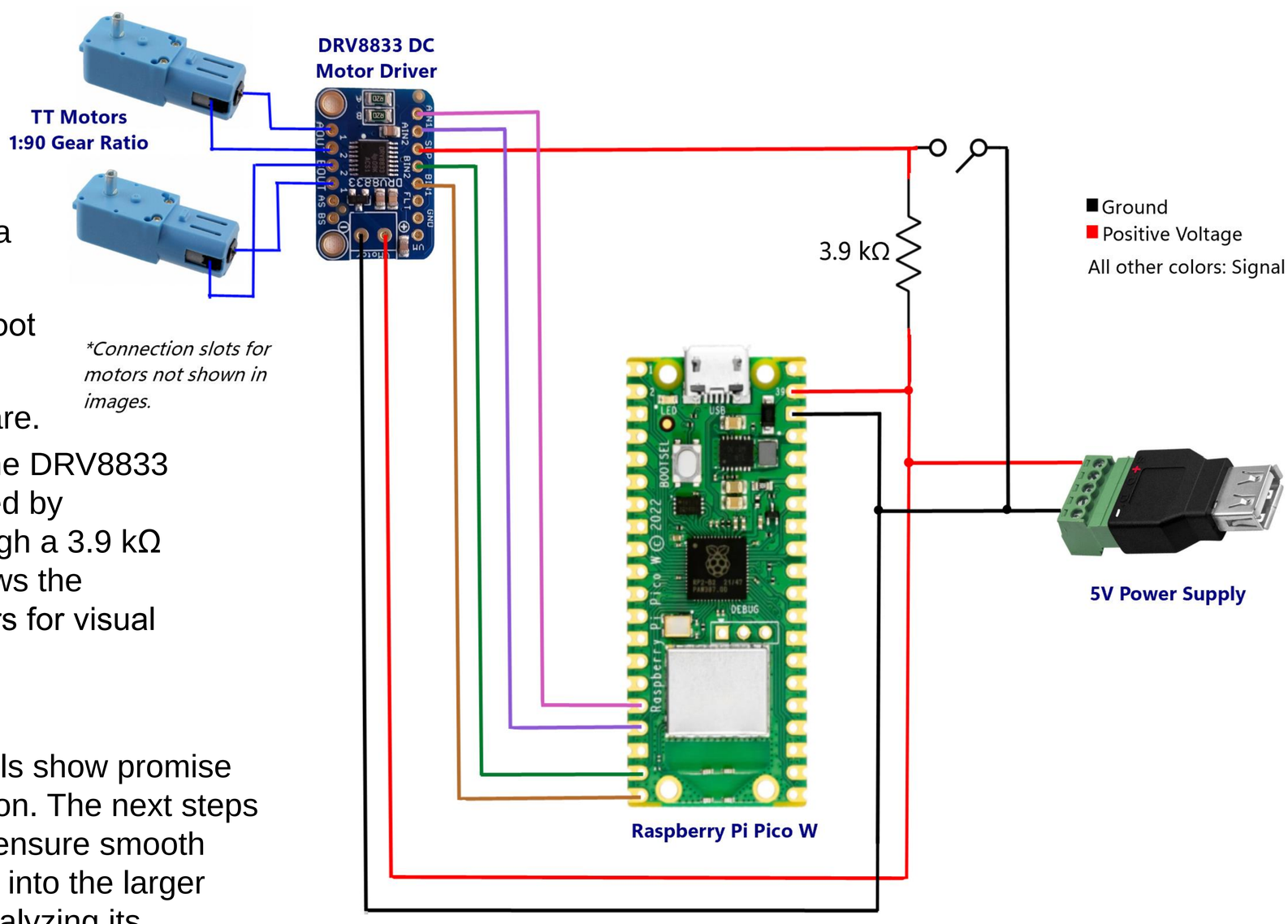
CAD model of RD prototype.



Sketch of the linkage orientation for scaled-up RD.

Building the Circuit

A MicroPython script on the Raspberry Pi Pico W drives the robot prototype. Since RD is a prototype and testing suspension system is the project's focus, only the electronics drive the robot forward. PWM (pulse-width-modulation) signals control the speed of the TT motors in the software. The motors receive the PWM signals through the DRV8833 motor controller. The motor controller is activated by connecting the on-board sleep pin to high through a 3.9 kΩ pull-up resistor. The schematic on the right shows the connections for only two of the robot's six motors for visual clarity.



Electrical schematic demonstrating how one set of DC motors are driven.

Results and Conclusions

The prototype proves that omnidirectional wheels show promise of implementation with a rocker-bogie suspension. The next steps for RD are continue improving the prototype to ensure smooth operation; then convert the scaled-down design into the larger version capable of supporting a payload and analyzing its environment through visual sensors such as LiDAR.

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