Wheely: Wheeled-Legged Quadrupedal Robot

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Wheely: An Accessible Platform for Experimenting with Wheeled-Legged Quadrupedal Robots

Aim

- **Design:** Create an accessible, low-cost wheeled-legged quadrupedal robot.
- **Technology:** Facilitate the proliferation of hybrid mobility technologies.
- **Experimentation:** Provide a platform for experimenting with wheeled and legged locomotion.

Literature review

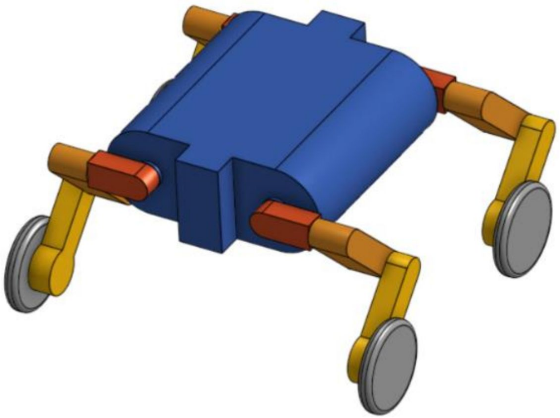
- **Market Gap:** There is a lack of affordable, accessible hybrid robots compared to high-cost models like ANYmal and RoboSimian.
- **Niche for Wheely:** Wheely is in a unique position to provide a low-cost alternative for low-risk research and development.

Methodology

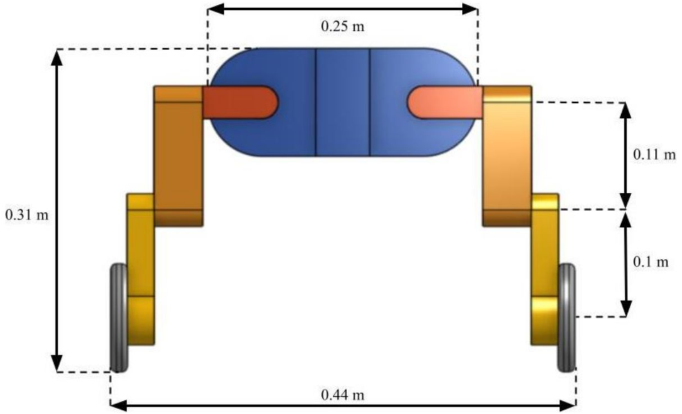
- **Design and Build:** Utilize economic servo motors, stepper motors, and a 3D-printed frame.
- **Control System:** Employ a Raspberry Pi and Arduino for locomotion control using open-loop gaits and Bezier curves.
- **Simulation Testing:** Conduct experiments in a simulated environment using Pybullet to test mobility and obstacle navigation.

Design

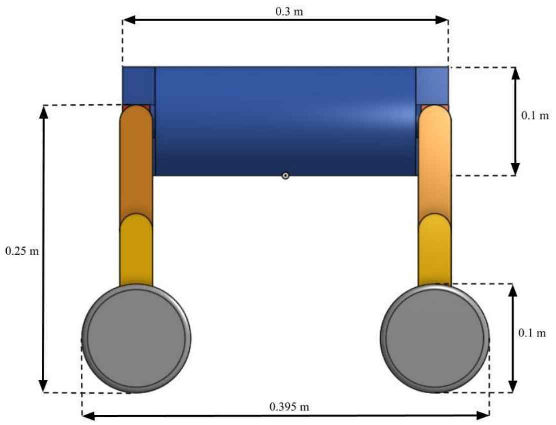
Isometric View



Front View



Side View



Results (Performance)

TABLE I. WHEELED VS LEGGED MAXIMUM CLEARANCE HEIGHT

H=20 cm	Clearance Height (cm)	Body Height Percentage
Legged	5	25
Wheeled	2	10

TABLE II. LEGGED VS WHEELED SPEED AND ENERGY CONSUMPTION

	Speed (m/s)	Traveled Distance (m)	Average Torque (N-m)	Watts Per Meter (W/m)
Legged	0.044	2.66	46.4	17.4
Wheeled	0.093	5.60	64.9	11.6

Results (Energy Efficiency)

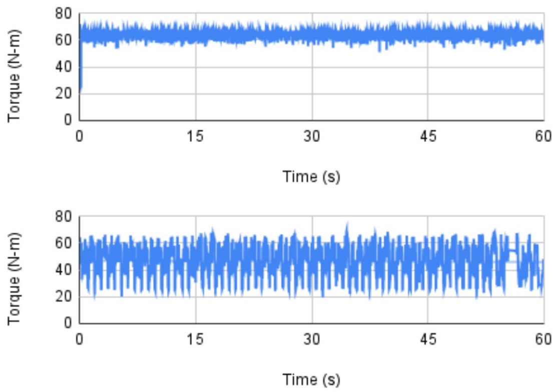


Fig. 4. Sum of legged and wheeled torque over one minute

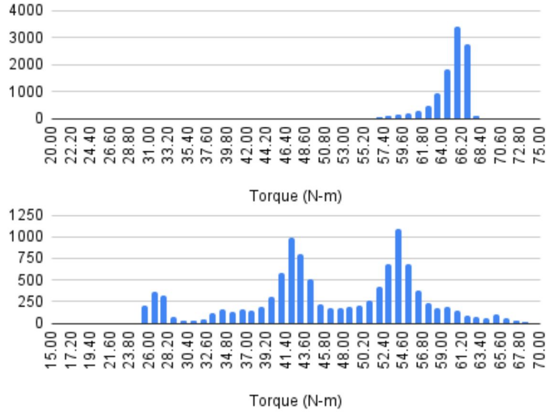


Fig. 5. Histogram of total torque over time for wheeled and legged locomotion

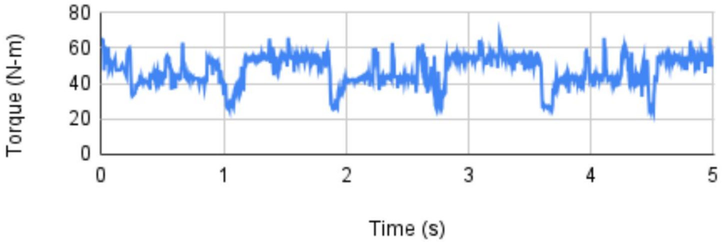


Fig. 6. Zoomed in view of torque useage over 5 seconds for legged locomotion

Conclusions

- **Technological Advancement:** Wheely marks a significant advancement in making wheeled-legged robotics more accessible.
- **Innovation Potential:** A low-risk testing platform is critical to future innovation.

Wheely: Supervised Learning for Online Selection of Blind Deep Reinforcement Learning Policies to Allow Robust, Specialized Gait Patterns

Aim

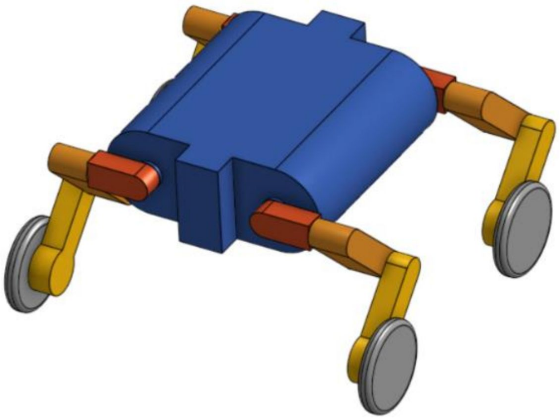
- **Gait Policy:** Use deep reinforcement learning to create robust, specialized, gait policies for any terrain.
- **Mixture of Experts:** Each policy is selected by a separate policy that identifies the type of terrain.
- **All Terrain Locomotion:** Robot uses the most optimal gait policy for any given terrain

Methodology

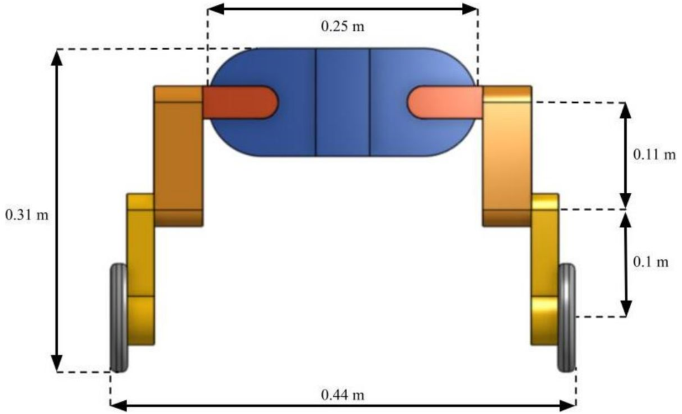
- **Train in Simulation:** Use Nvidia Isaac Gym to to train deep reinforcement learning policies rapidly in parallel.
- **Environment Identifier:** Use supervised learning to create neural network to identify terrain type.
- **Further Testing Simulation:** Simulation tested in both Isaac Gym and Pybullet to minimize sim to real gap

Design

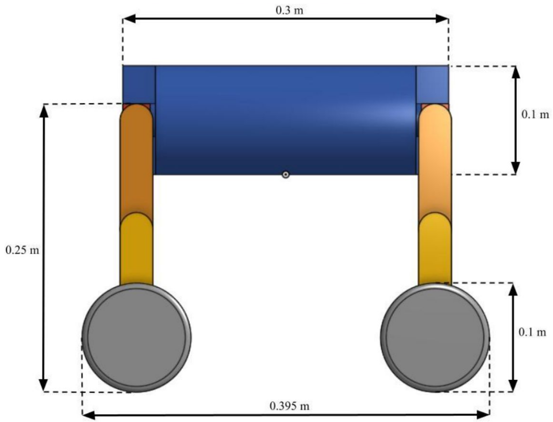
Isometric View



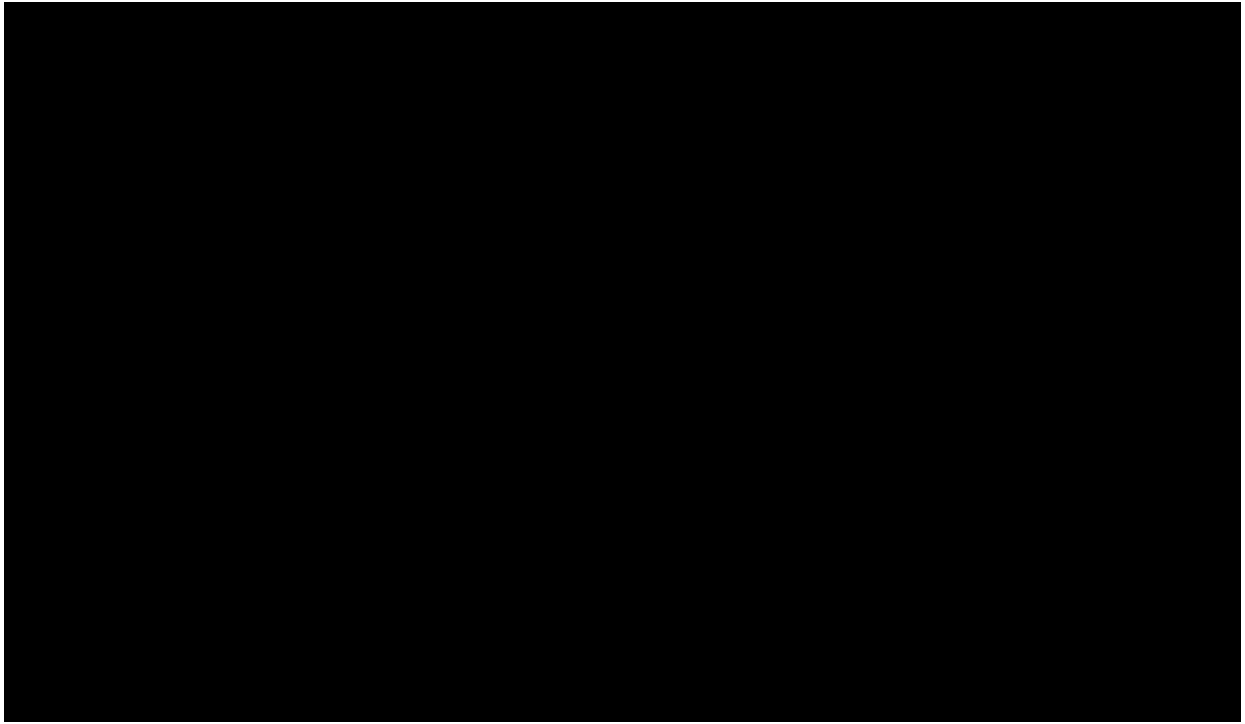
Front View



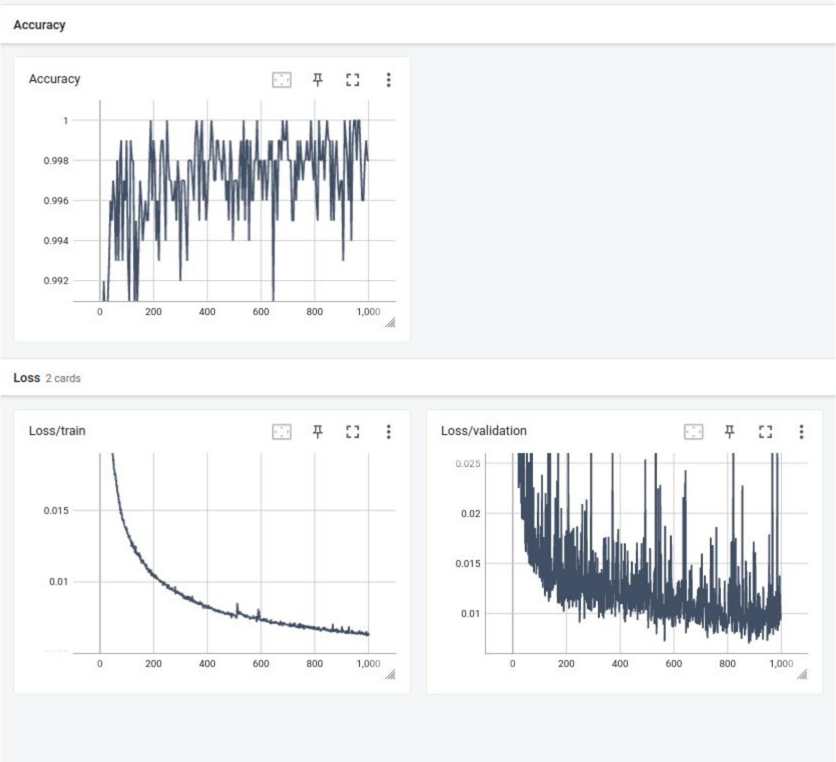
Side View

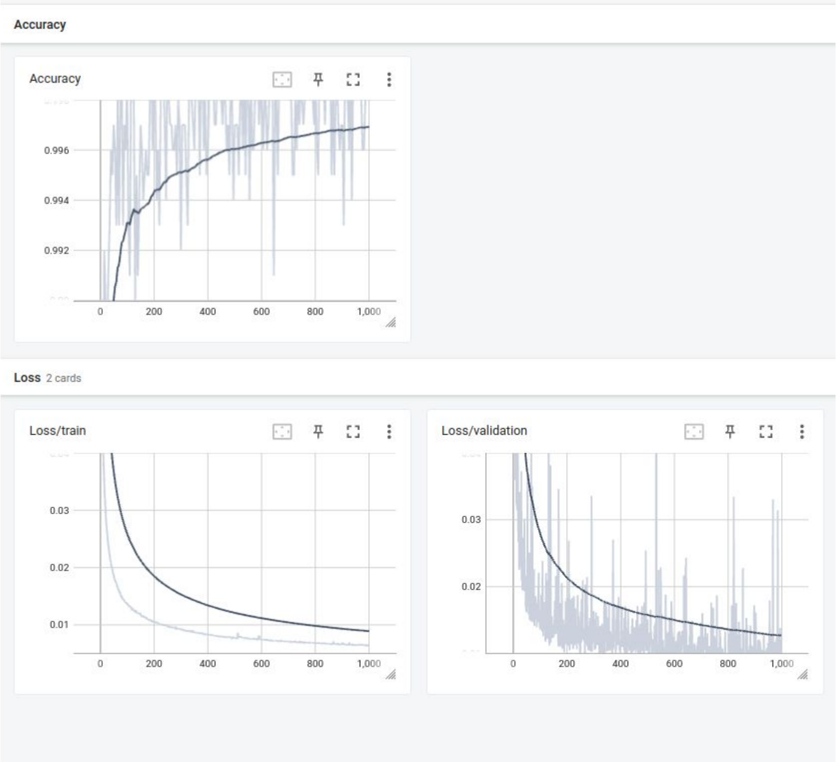


Results (Deep RL Gait Training)



Results (Supervised Learning Environment Selector)





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Thanks!

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