OLLY

Oversized Load Lifting and Yielding

A novel robotic take on specialized transportation

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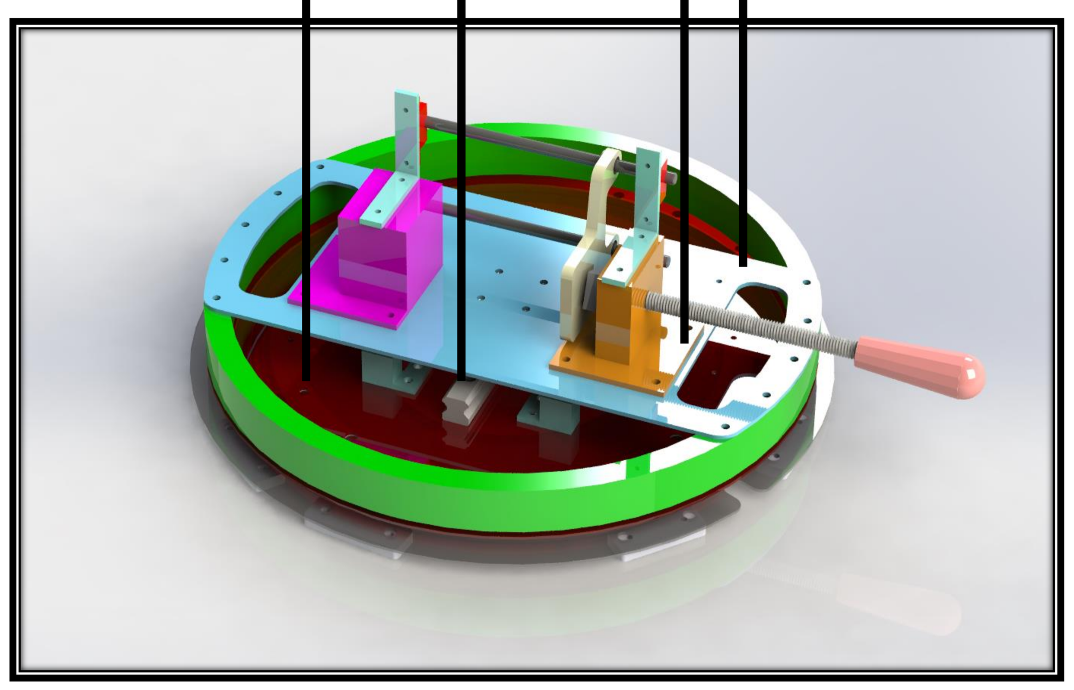
Hardware

Thrust bearing results in rotational compliance of the vise about the center of the robot

Linear rail creates translational compliance along the axial direction of the load, accounting for deviations from the desired trajectory (only on Molly)

Sliding vise used to clamp any load type

Pegboard allows for modular mounting format, so other custom gripper mechanisms can be used

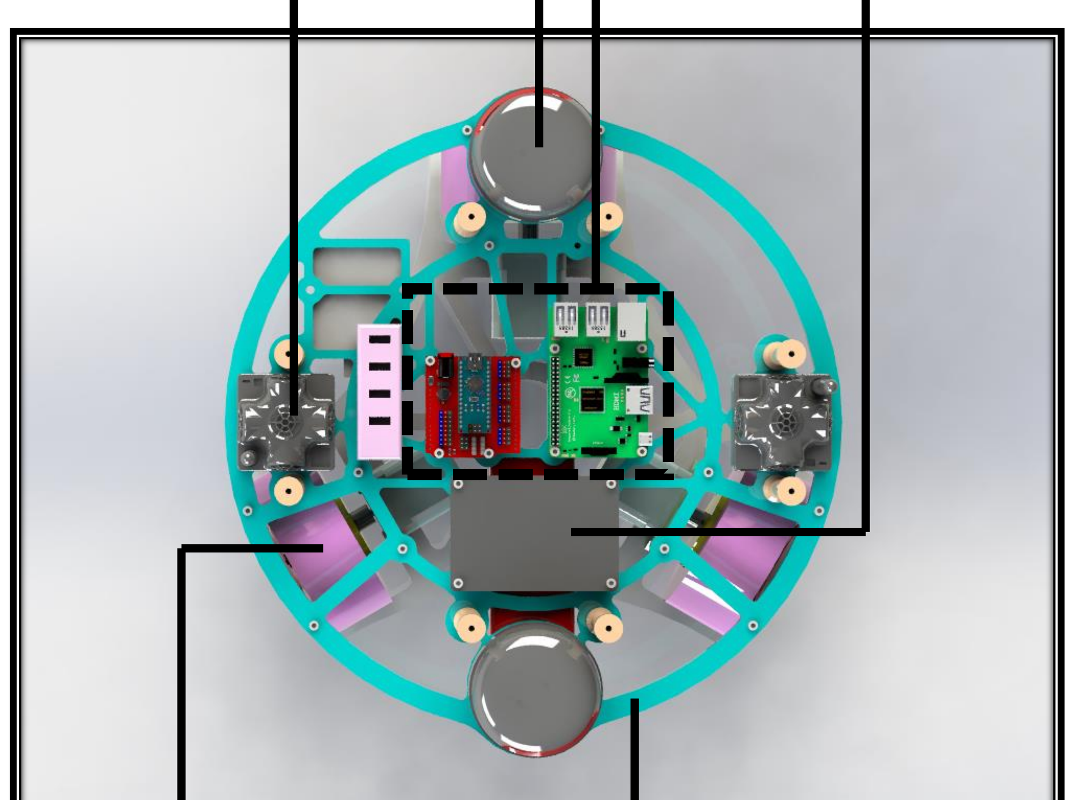


Two LIDAR sensors are used to map the surroundings on opposite sides

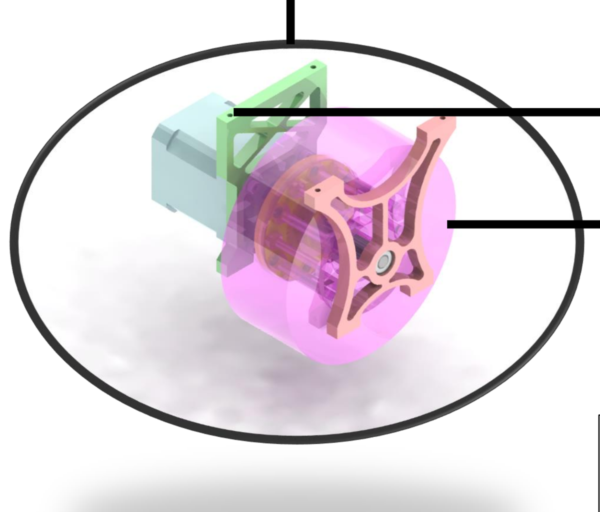
Indoor GPS units help find the localized position of each robot

On-board computation is handled by the Raspberry Pi, which utilizes the Arduino Nano to send signals to the motors

Custom circuit board uses H-bridge to drive omnidirectional wheel



Pocketed baseplate for sleek lightweight performance

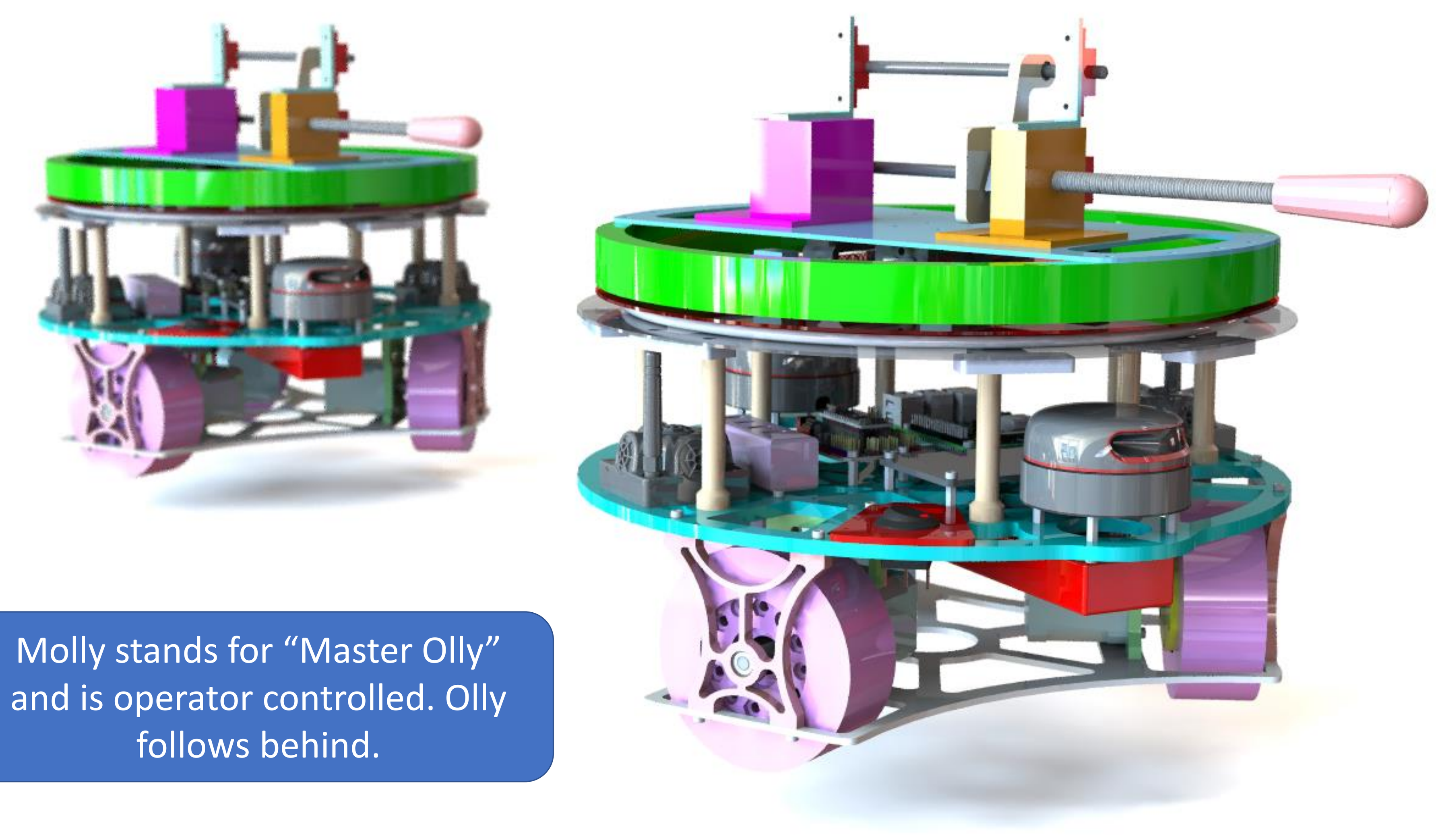


NEMA-17 stepper motors used with microstepping to enable precise and fast actuation

Omnidirectional wheels in the triangular (kiwi) formation allowing for any directional or rotational input

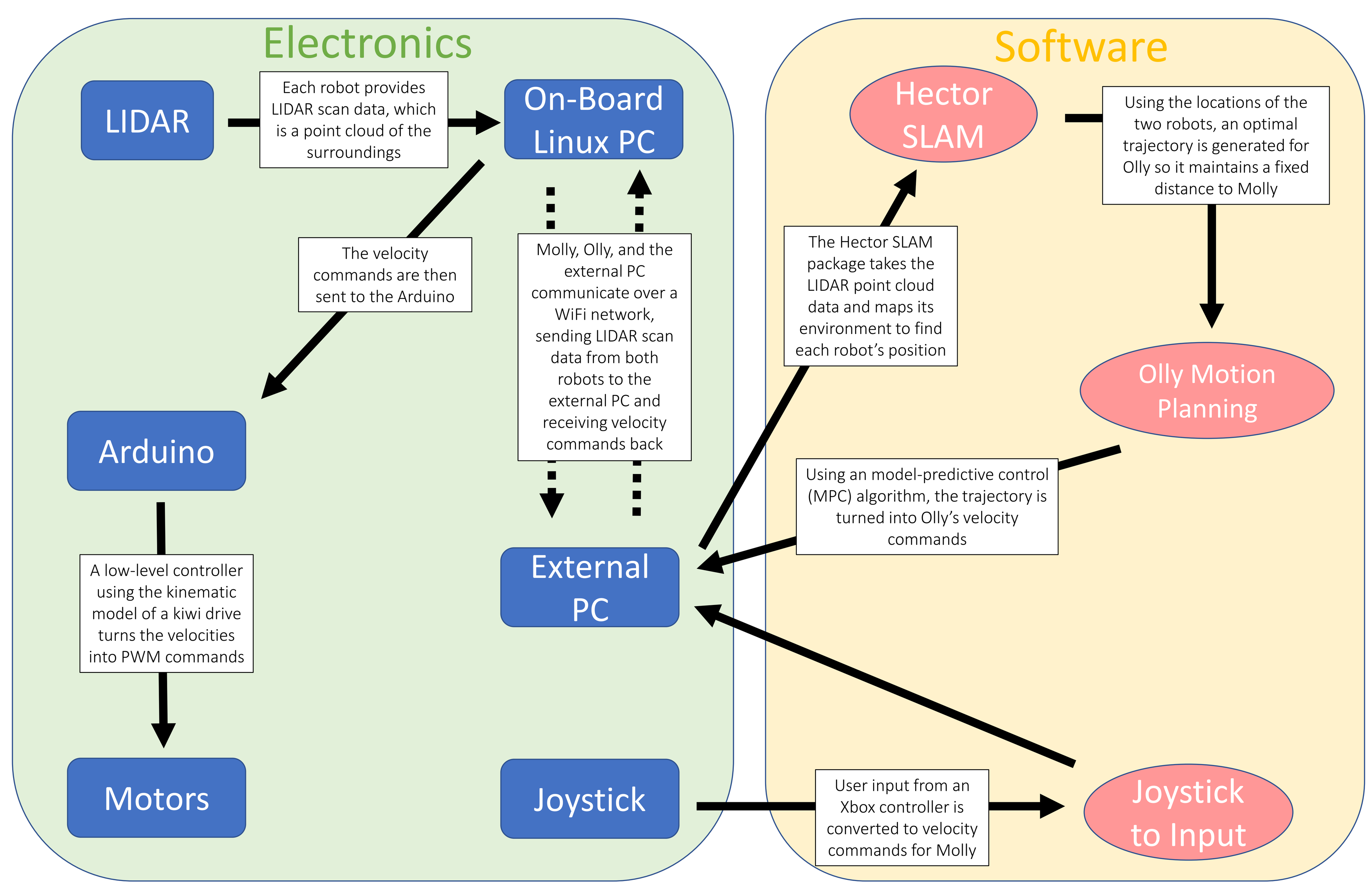
Meet Molly and Olly

Molly and Olly are a pair of transportation robots designed to carry loads too long for one vehicle alone, such as wind turbine blades and rocket boosters. By utilizing omnidirectional drive wheels and both translational and rotational compliance, Molly has the ability to move in any direction from a user input, while Olly will automatically maintains a constant distance to protect the load.



Molly stands for "Master Olly" and is operator controlled. Olly follows behind.

How They Communicate

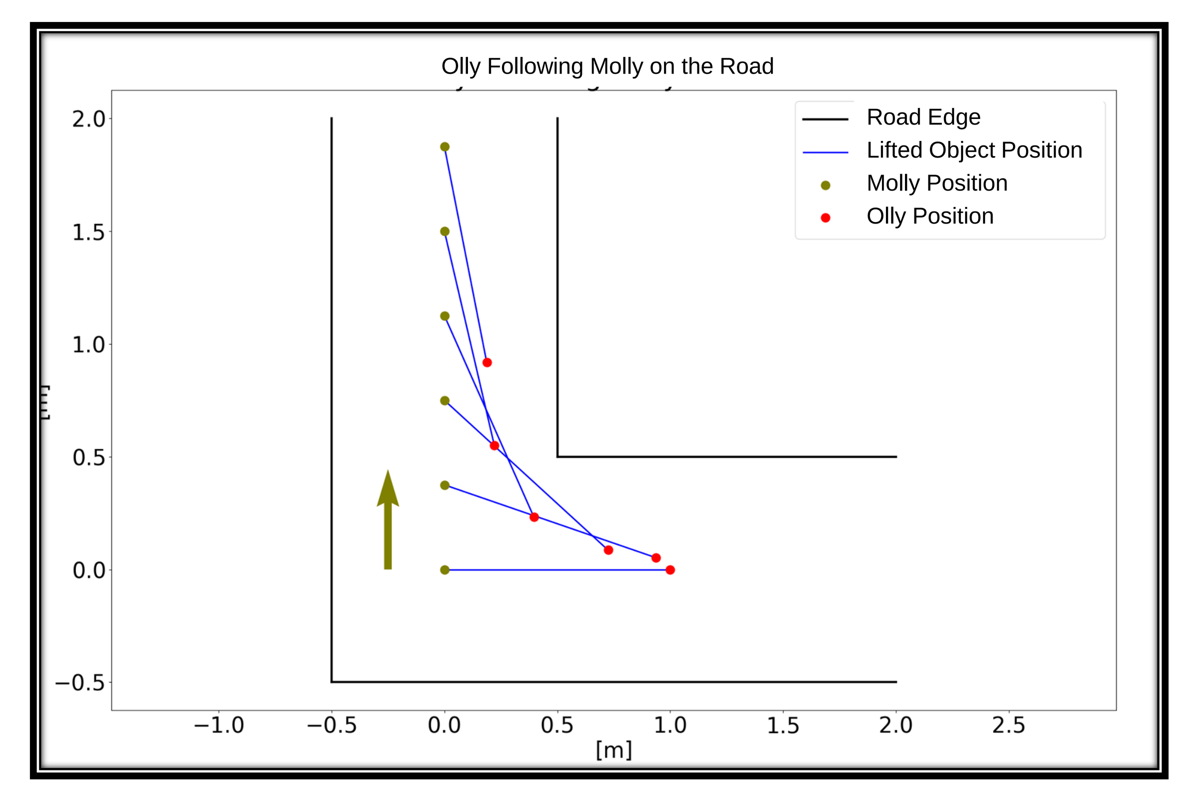


The OLLY team would like to acknowledge Professor Homayoon Kazerooni and our GSIs—David Cuban and Julia O'Donnell—for their continued assistance in the creation of Molly and Olly. We would also like to thank the Etcheverry Shop staff—Scott, Jacob, Jeff, Katherine, and Dennis—for their invaluable help in the fabrication of these robots.

Software

LIDAR sensors rotate at high velocity and fire laser beams into their surroundings to measure distance, which gives them spatial information of their environment. This data is accumulated over time, and is used to build a map of the robots' environment and localize them in it.

We use a Simultaneous Localization and Mapping (SLAM) algorithm to turn the LIDAR point cloud into a map of the robot's surroundings. The image shown above is a map that we built of the basement of Hesse Hall. The darker a line is, the more confident the robot is that that region is a solid wall.



Using the SLAM map, a model predictive control ("MPC") optimization problem determines Olly's behavior. By predicting Molly's future behavior, Olly's controller computes a trajectory that maintains a specific distance from Molly and avoids obstacles. The picture above shows Olly's path given a simple trajectory for Molly.

Project Olly can solve a number of complex transportation problems.

Assembly of massive equipment such as wind turbines and commercial airliners often happens in separate locations, which requires companies to transport large parts like wings over land. Traditionally this has happened with two trucks that split the front and back end of the load.

Olly can be scaled up to better address these transportation scenarios with an autonomous solution.