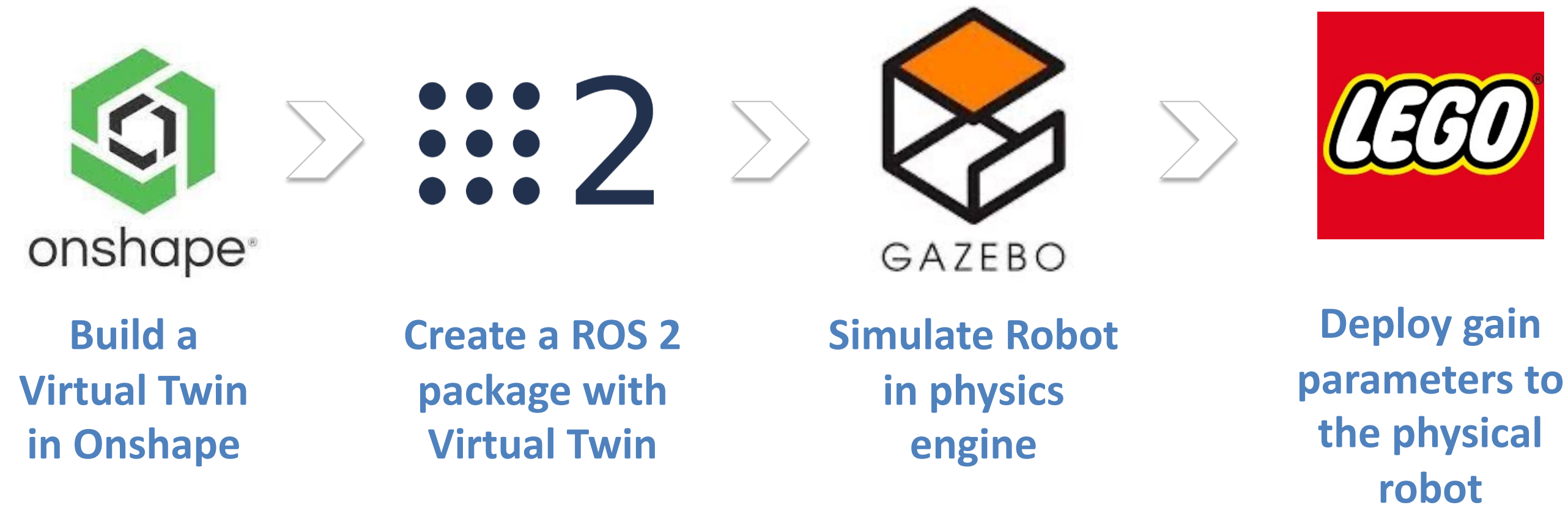


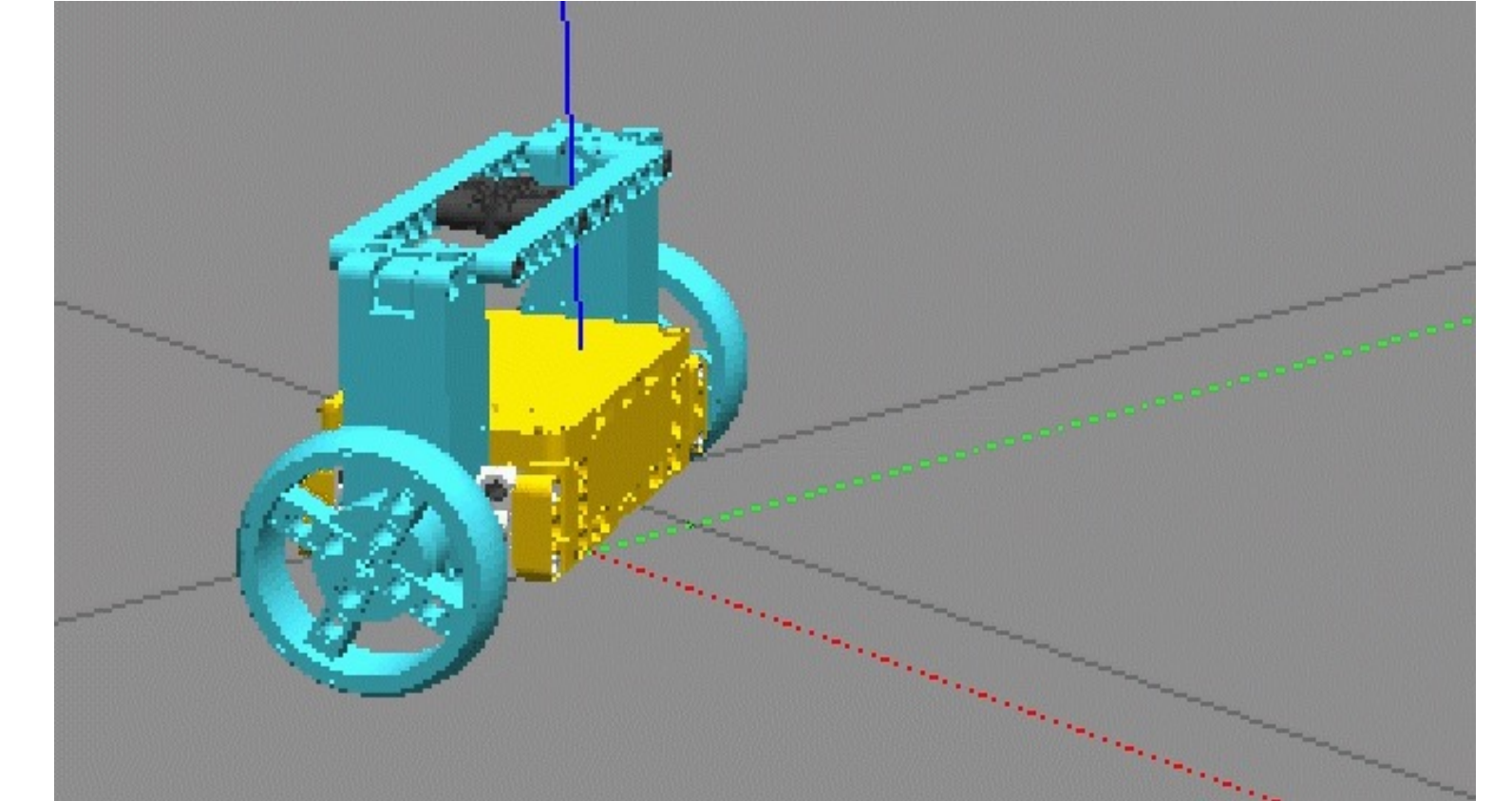
High Level Process: Creating a Virtual Twin to Train a Balancing Robot



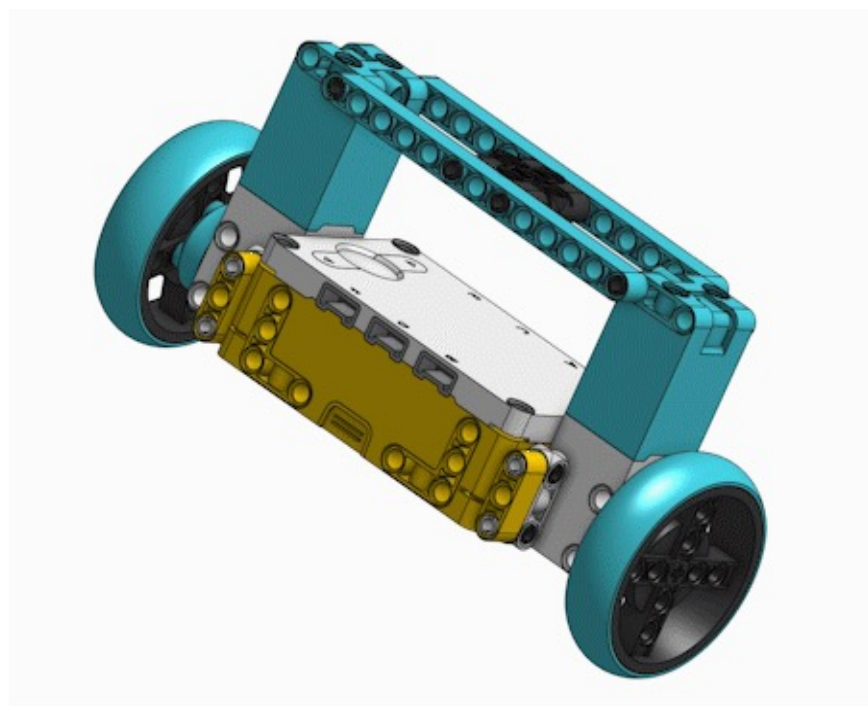
Simulating the Robot in Gazebo and ROS 2

Measured and assigned weights for each component

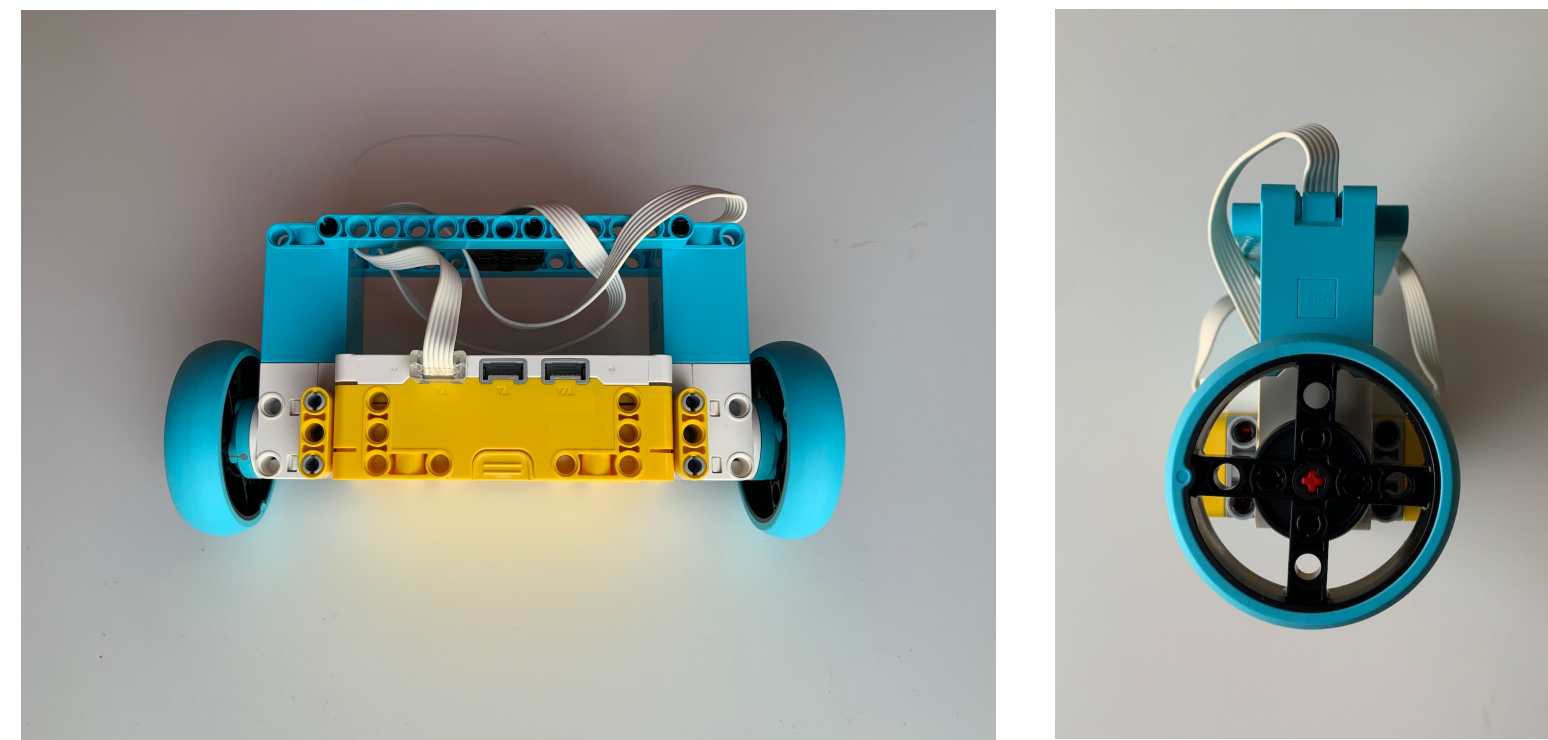
Formatted the virtual twin in SDF format and created a ROS 2 package which includes a control script



Modelling and Building the Balancing Robot



Virtual model is built in Onshape using LEGO SPIKE Prime document that I helped to create

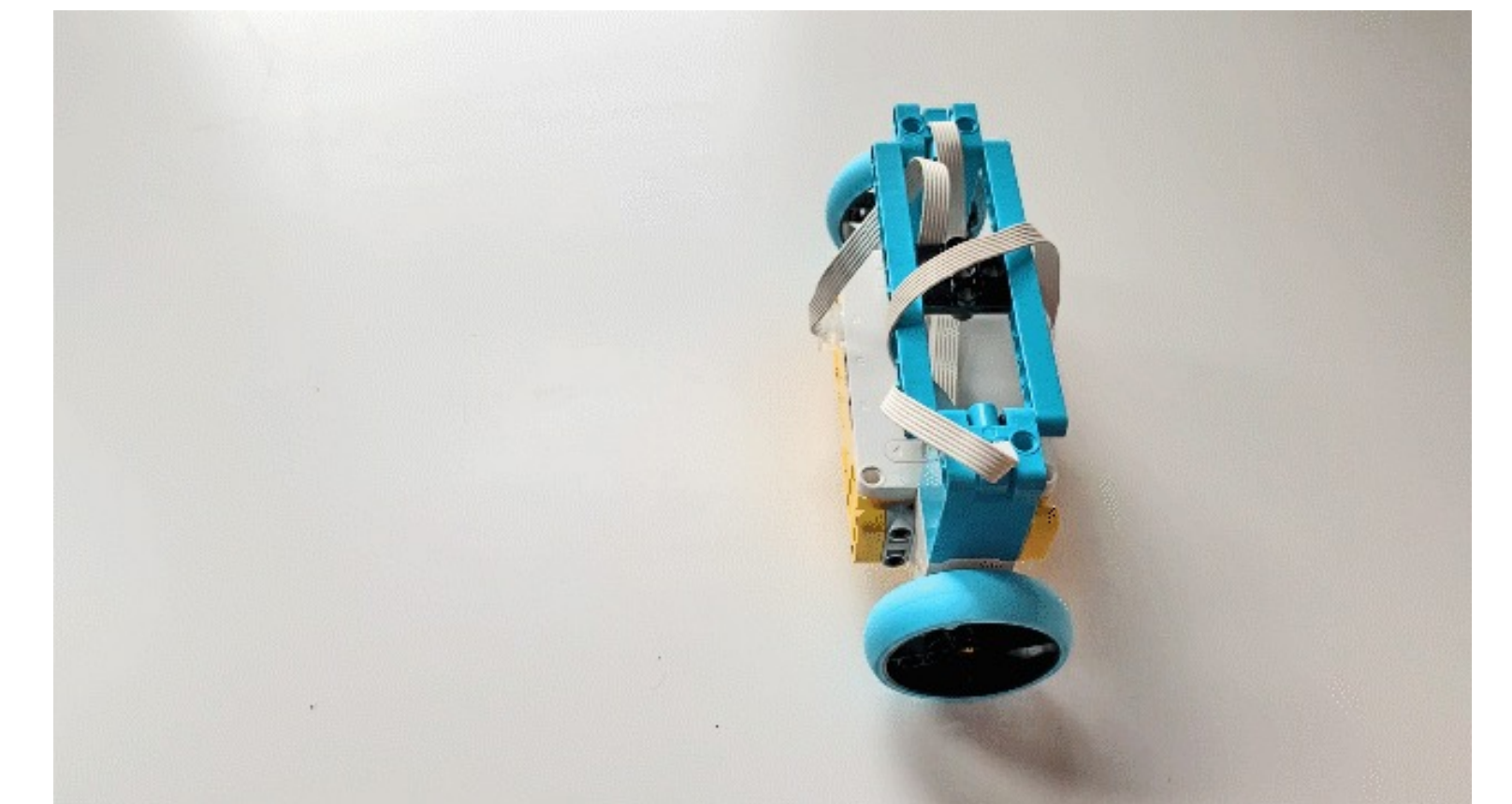


Physical Model is built in tandem with the virtual twin in order to create a physical testing base for the simulation.

Validation: Applying the Simulation Generated Gains to the Physical Twin

Gains generated from the simulation are then applied to the physical twin.

SPIKE Prime is running its own control loop on its lower-level hub class in order to command PWM pulses to the motor pair.



Implications and Future Steps

- After developing a base connection, other control techniques could be tested in Gazebo and deployed to the SPIKE Prime.
- Machine learning or AI techniques could be used to drive the tuning of the system, i.e. polynomial regression
- Characterizing the motors and the attempting to find the friction coefficient on the rubber on the wheels would increase simulation accuracy.