The robot will be relying on three wheels in a triangle formation for driving and steering. Two rear wheels will be responsible for driving the robot, as well as utilize differential steering. Aside from being a free spinning support for the front side of the robot the front pivot wheel will also follow the tape, as it is the rough location of the QRD1114 sensors used for the sensor system.

The speed required was calculated using an estimated distance that needs to be travelled by the robot throughout the whole competition (i.e. distance of the taped and untapped portion), where this distance was equal to 265 cm. Ideally, the robot needs to travel this distance in about 30 seconds without picking up any pets, granting the robot 90 seconds locating, retrieving, and delivering pets. Thus the speed which the robot is required to travel is:

Calculating the wheel radius takes into account that the robot must maintain this speed during the most extreme condition, that being the uphill climb on the ramp. Using the figure below and assuming ideal conditions we find the equations of motion of the climb as:

Combining these equations:

Assuming that the robot spans the entire allowed space, the axles of the wheels are at the bottom corners of the robot’s length, and that the center of mass G is located exactly in the middle we find the following values, as well as other assumptions:

Using these assumptions, the new function looks like:

We can calculate the gear ratio R using the following equation:

Where is the maximum torque of the ungeared motors, which is 0.2 Nm, transforming our function to:

Taking the velocity required as function of the wheel radius in rpm, we find:

Thus finding the wheel radius as:

Thus our gear ratio and torque will be:

Since the tangential velocity of the wheels will be 9 cm/s, the transmission calculations to find the power required for the motor are:

Where

Given a distance as the distance of the sensors from the pivot point of the back wheels, and take it as the maximum allowed length of the robot (16 inches = 0.4064m), then the angular acceleration can be found as:

Thus, we find the required torque to be:

For a wheel axle length equal to the width of the robot (12 inches = 0.3048m) and axle mass of about 0.1 kg, then:

Thus the required power comes to be:

Please note that these calculations represent extreme assumptions and ideal conditions, and the values may not fully represent the actual finished product. However, the equations will be used once the values assumed for this proposal have been properly defined.