PTC / NJ FTC Design Challenge – March 2015

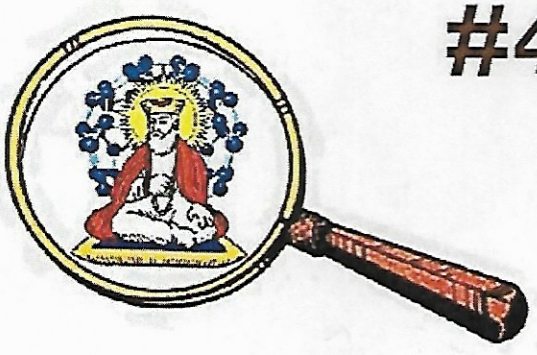
"Parkway Pole Painter"

ENGINEERING NOTEBOOK

By: Ron Gorai of the NanoGurus

NanoGurus

#4347



FTC

FIRST Tech Challenge

NanoGurus #4347

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Scenario

NJ FTC announced three scenarios for the 2015 PTC Design Challenge. Following is the scenario that I have chosen.

Scenario 2: "Parkway Pole Painter"

The State has decided to paint all of the 50-foot tall light poles on the Parkway. (Don't ask us why.) Your robot needs to shimmy up the pole, and then apply paint from spray cans mounted on either side of it on its way down. Extra credit is given if the robot uses two different colors and paints a nice yellow and green spiral on the way down. Alternatively, if your robot can also paint the northern face of the pole, yellow and the southern face of the pole, green... that's worth more extra credit.

Design Concept

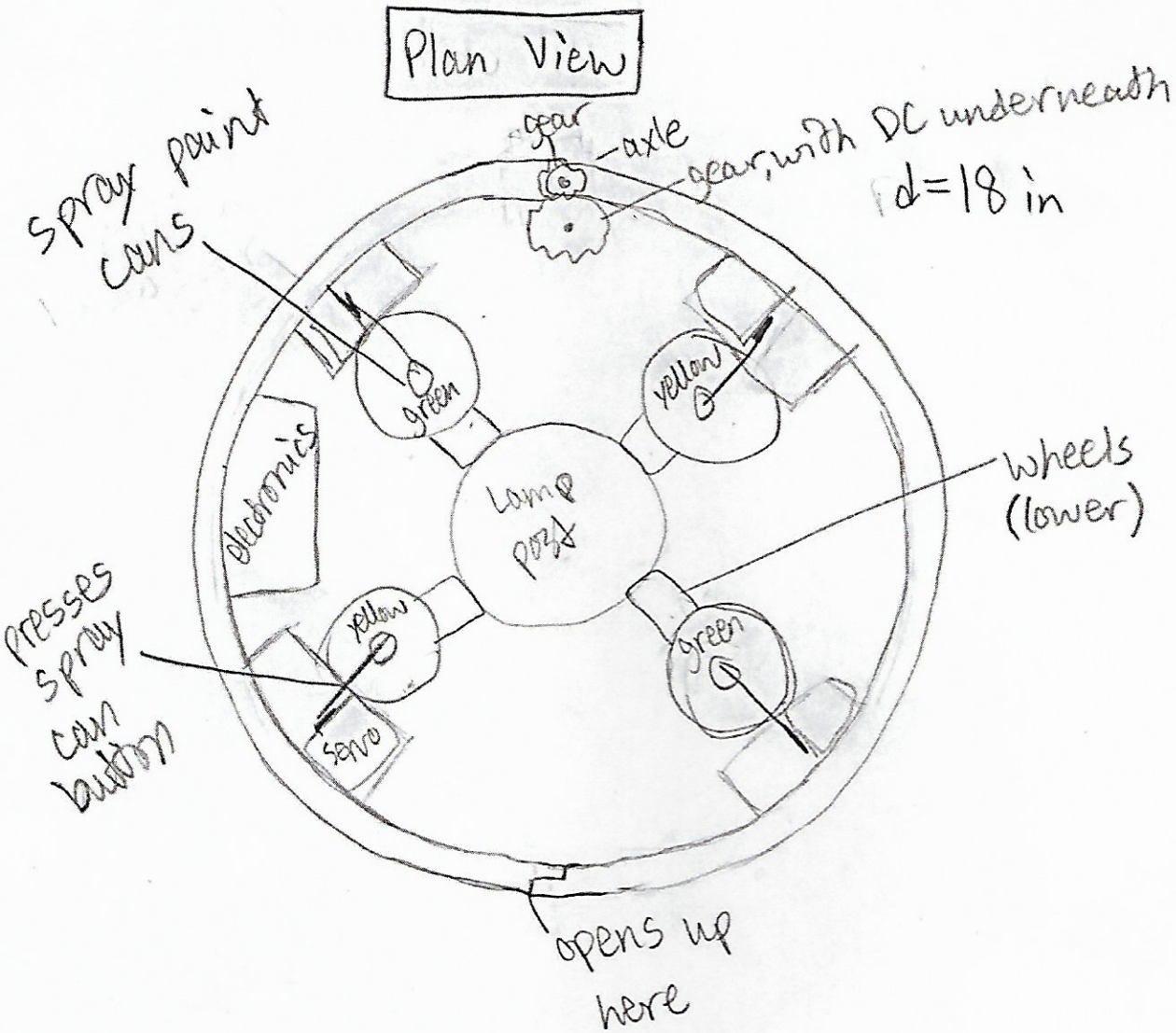
First, the robot opens up from a hinge and wraps itself around a pole that is 5 inches in diameter. Then, it moves up the pole in a spiral for a pre-determined distance until it gets to the top of the 50-foot pole. After that, it moves downwards at a specified speed while spraying paint from the spray cans, which are operated by servo levers. The angled wheels enable the robot to travel in a spiral, ensuring the paint is applied in a spiral. Last, robot stops at the bottom of the pole after traveling downwards for the same pre-determined distance.

The following pages contain the details of the robot.

Rough Sketches

Ron Gorai 2/22/15

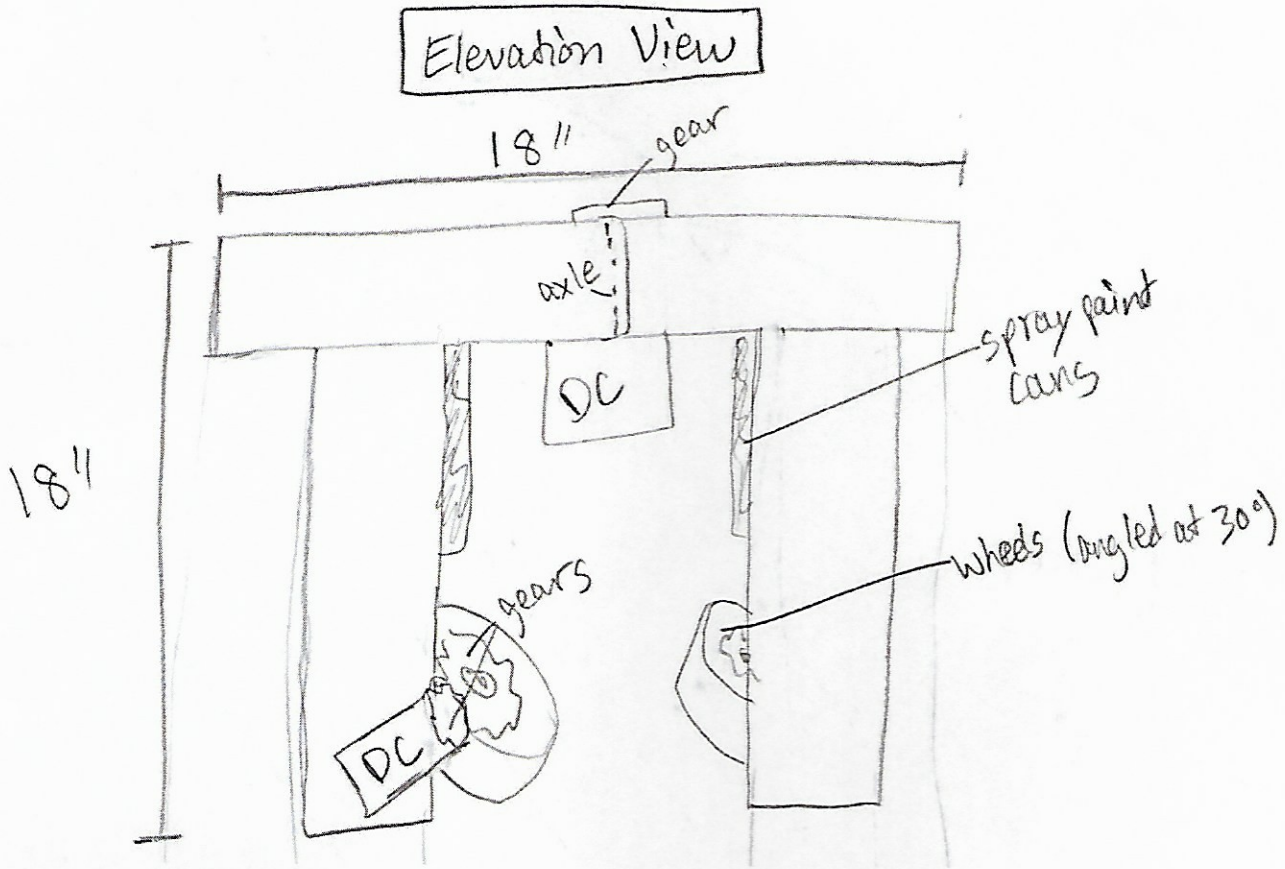
PTC Challenge "Parkway Pole Painter"



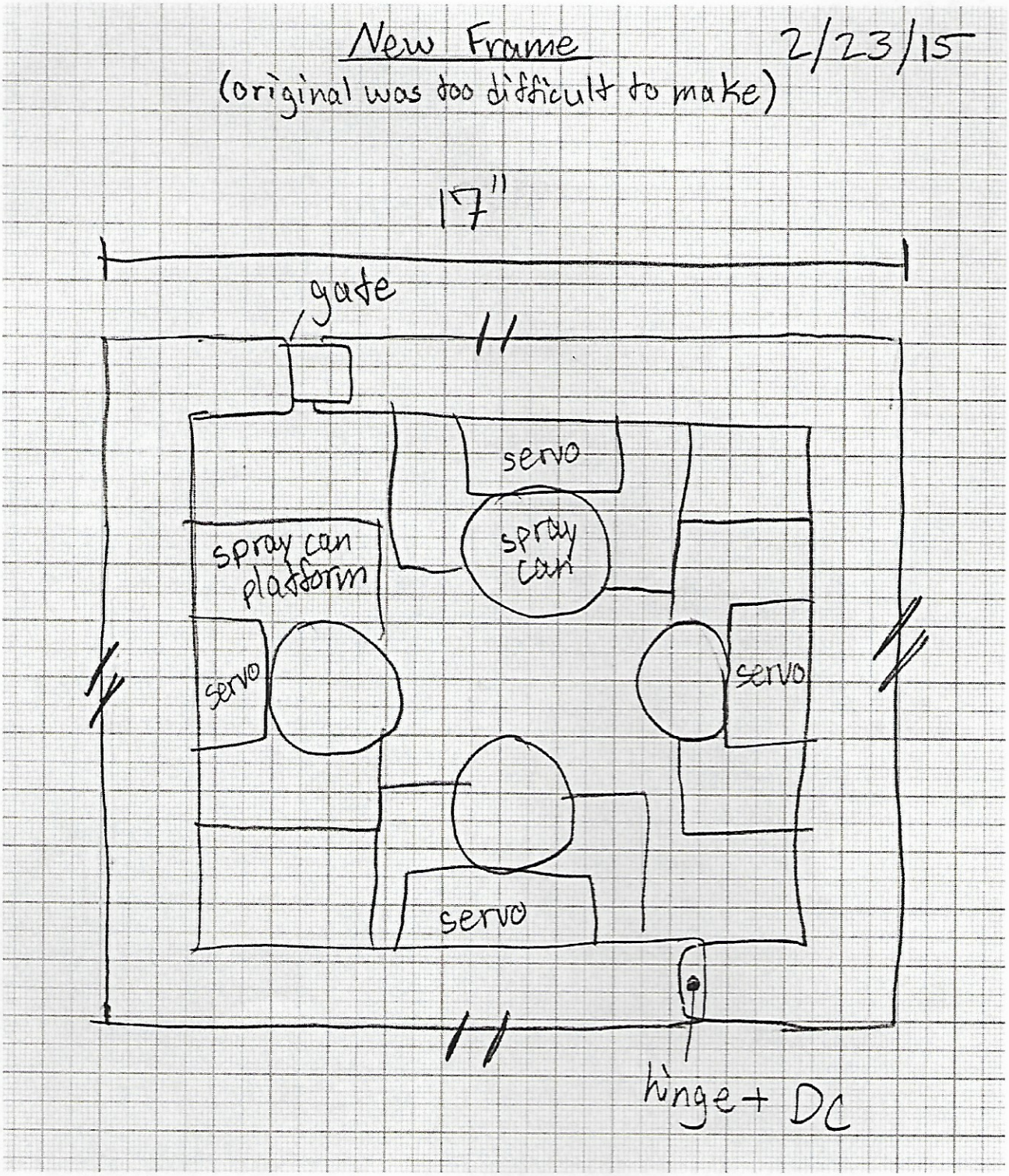
Rough Sketches (cont.)

Ron Gorai 2/22/15

PTC Challenge (cont.)

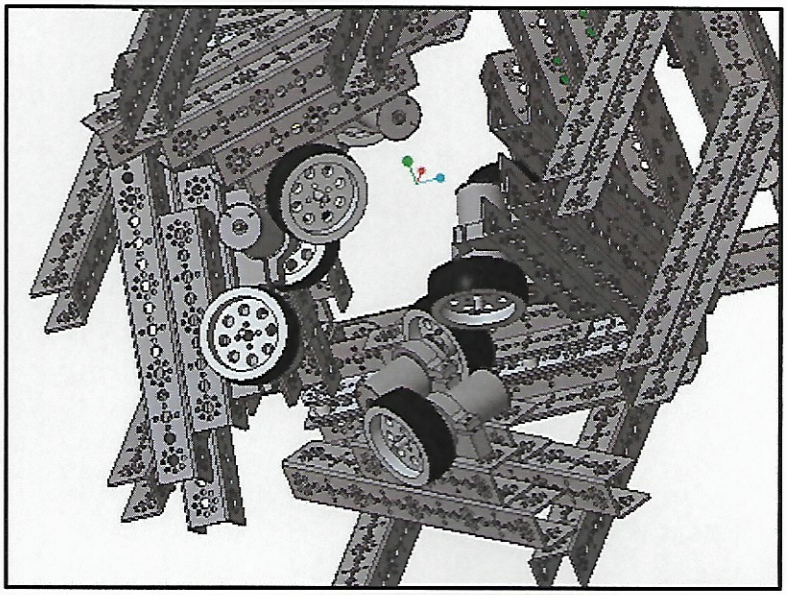


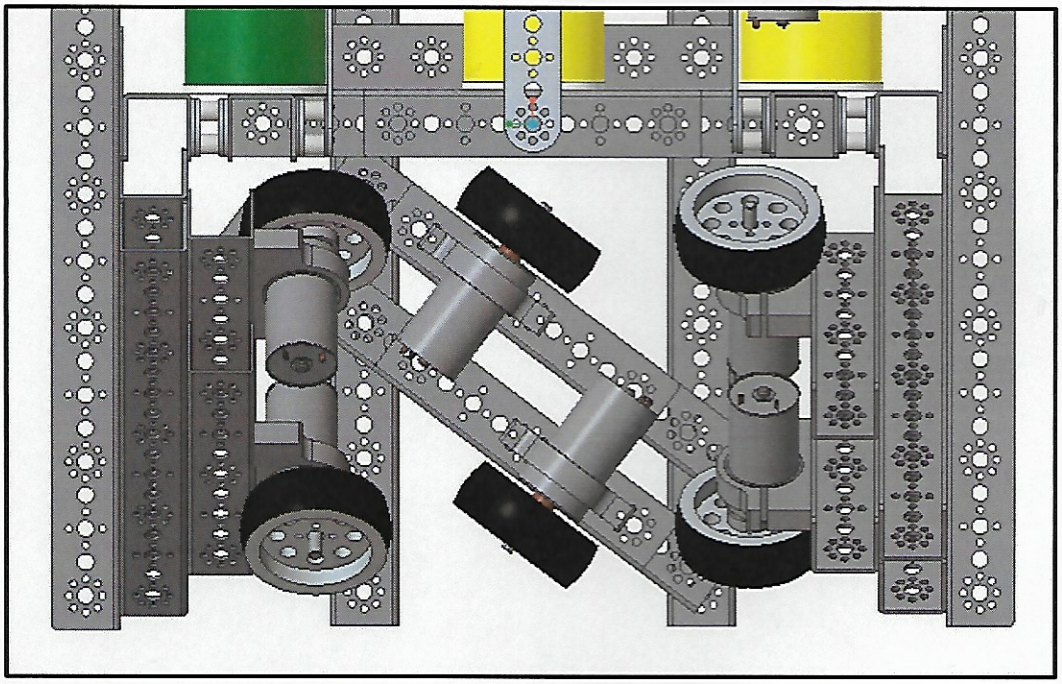
Rough Sketches (cont.)



Drivetrain Mechanism

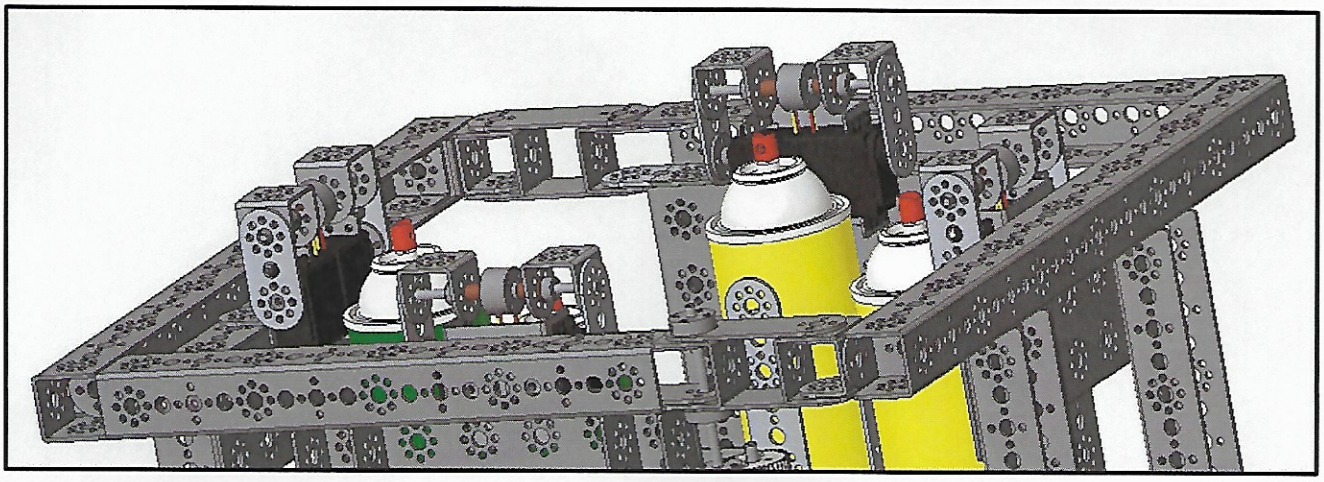
I named the drivetrain of my robot a "double angled-wheel" chassis. This is because there are two wheels in the middle of each of the four sides of the robot. These two wheels are located in the middle of the face and are angled at around 45°. This allows for the robot to spiral up and down the pole. It is made to drive on a 5-inch-diameter pole.

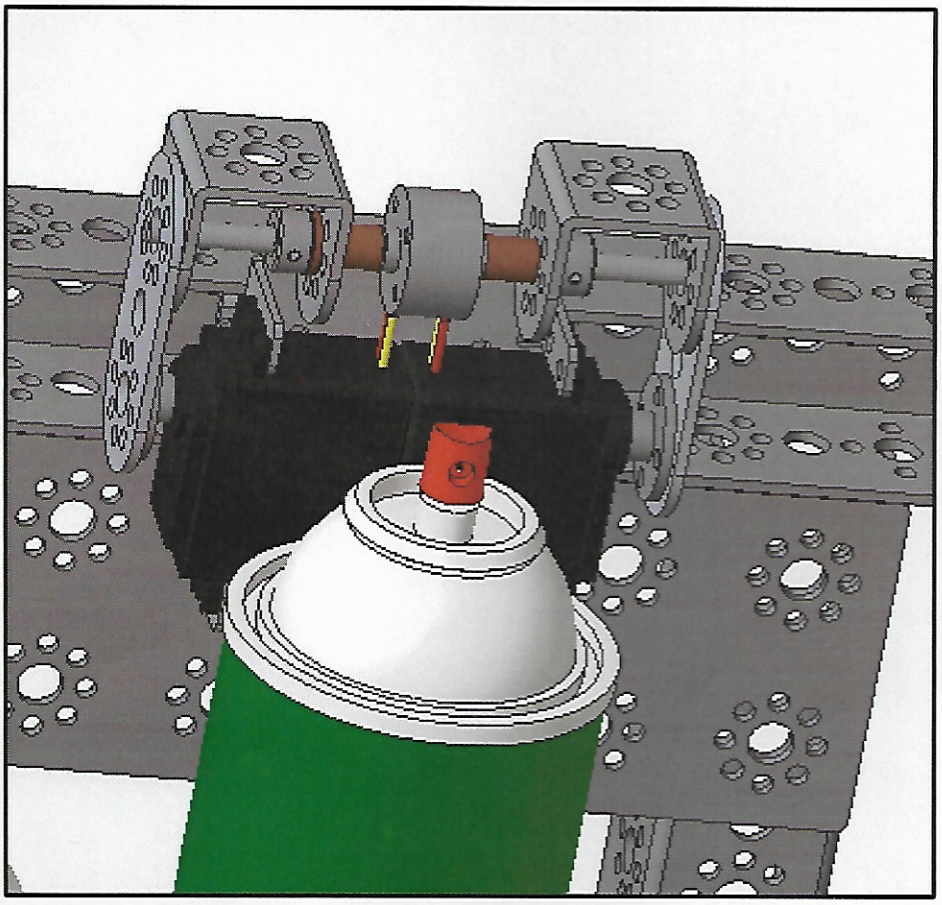




Spray Mechanism

The mechanism that activates the spray can is a lever that presses down on the spray can button. This is powered by two servos.

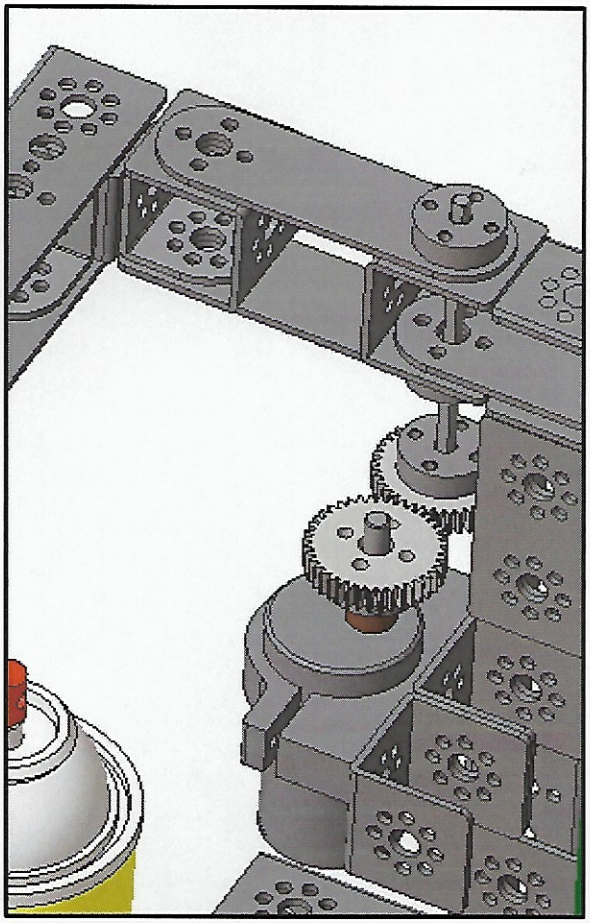




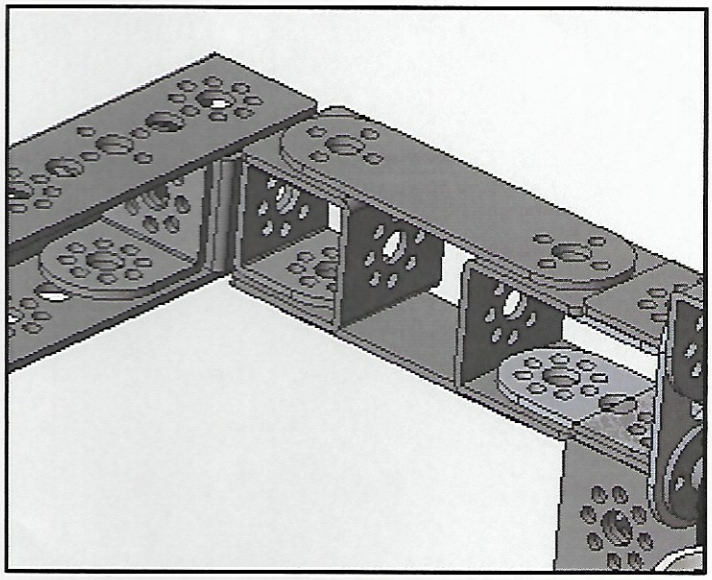
Hinge Mechanism

Since the robot can't magically wrap itself around the pole, I incorporated a hinge-and-gate mechanism that allows the robot to be opened and closed. This way, the robot can actually grip itself around the pole. This is all powered by one DC motor.

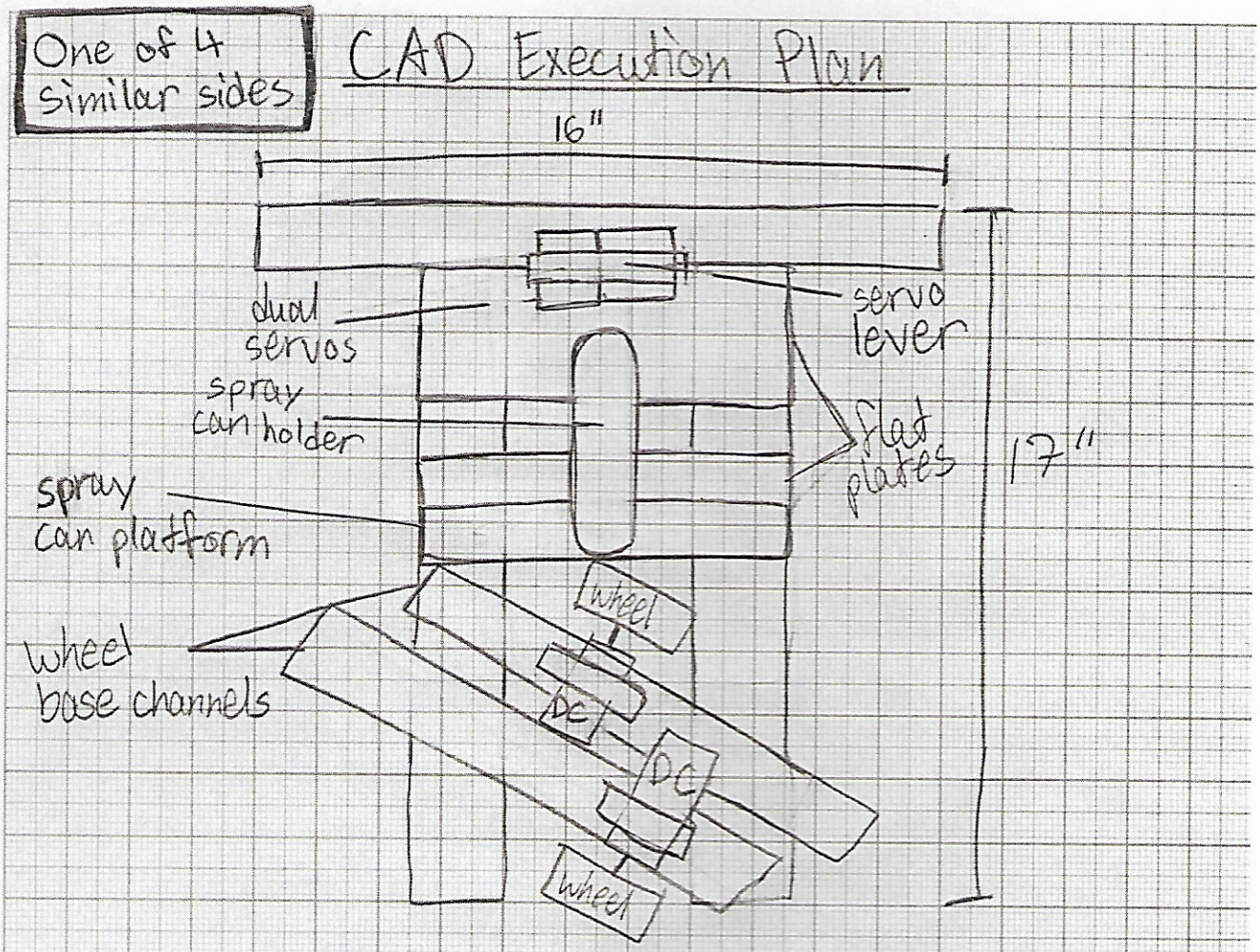
Hinge



Gate

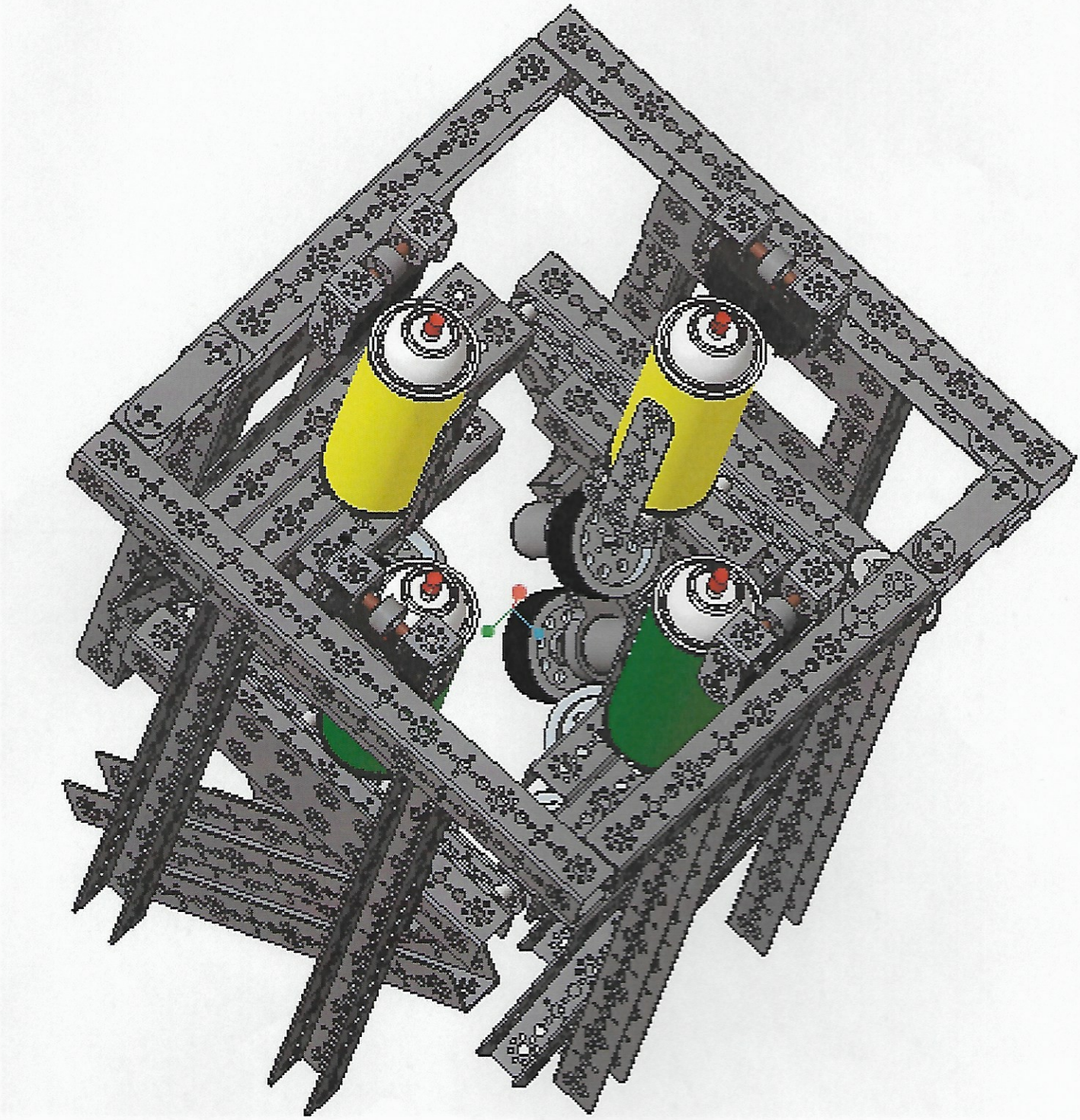


CAD Execution Plan

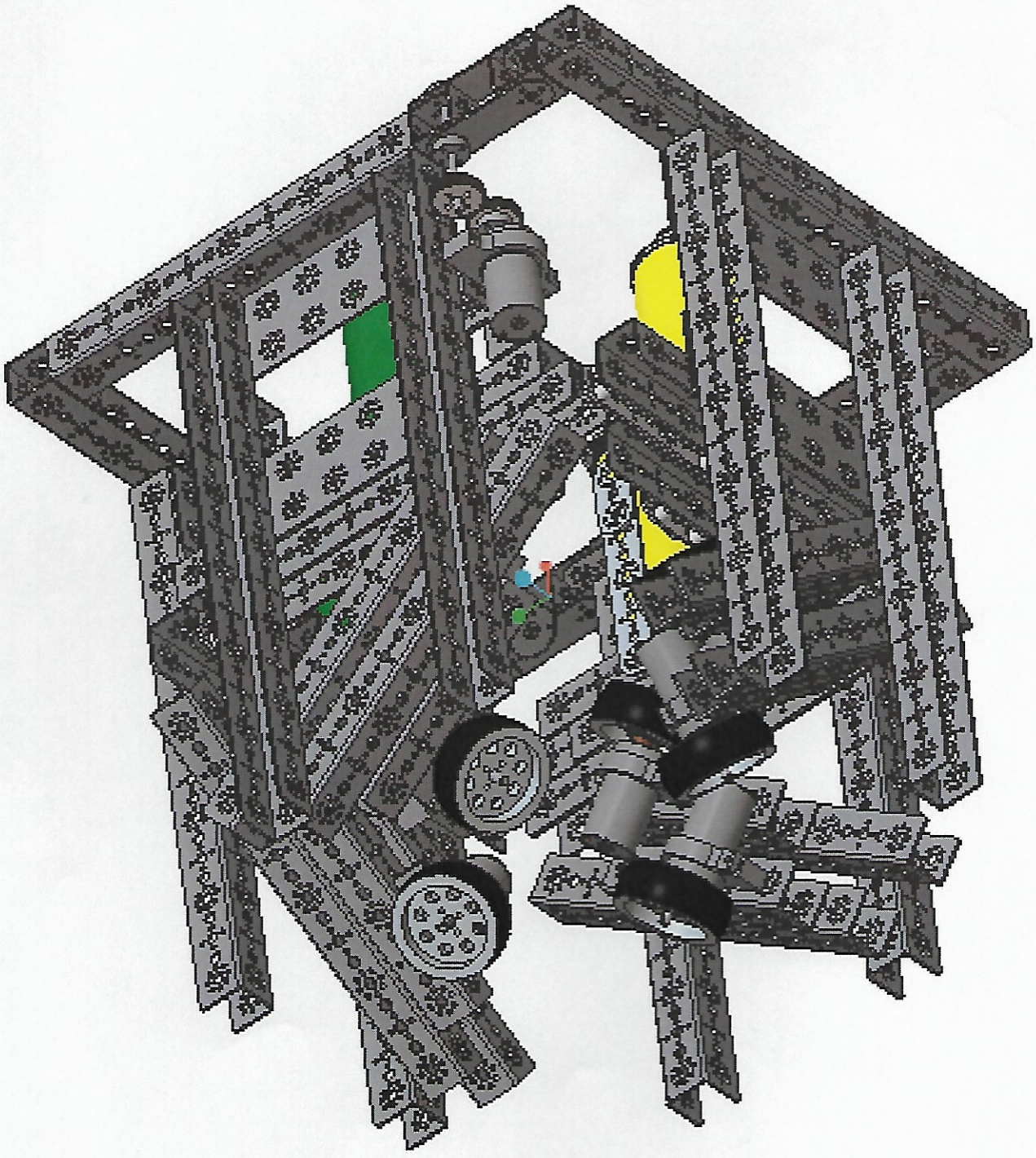


1. Start with longest channel
2. Insert dual servos and lever
3. Attach flat plate and longest channel to servo holder
4. Attach flat plate to middle of two channels
5. Insert 4 wheel base channels
6. Attach DC mounts and motors, hubs, and wheels
7. Attach spray can platform to middle flat plate
8. Finish with spray can holder

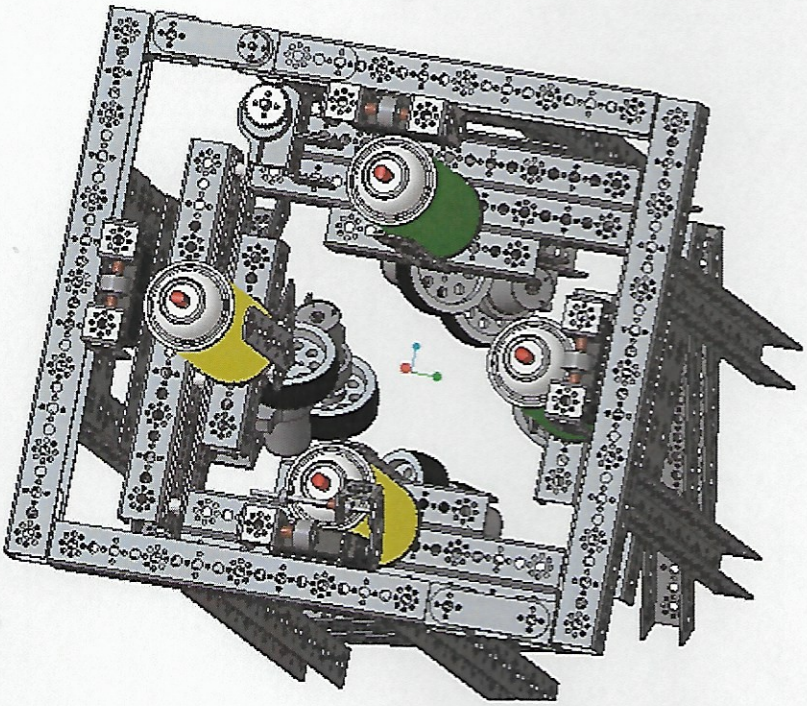
Final PTC Product

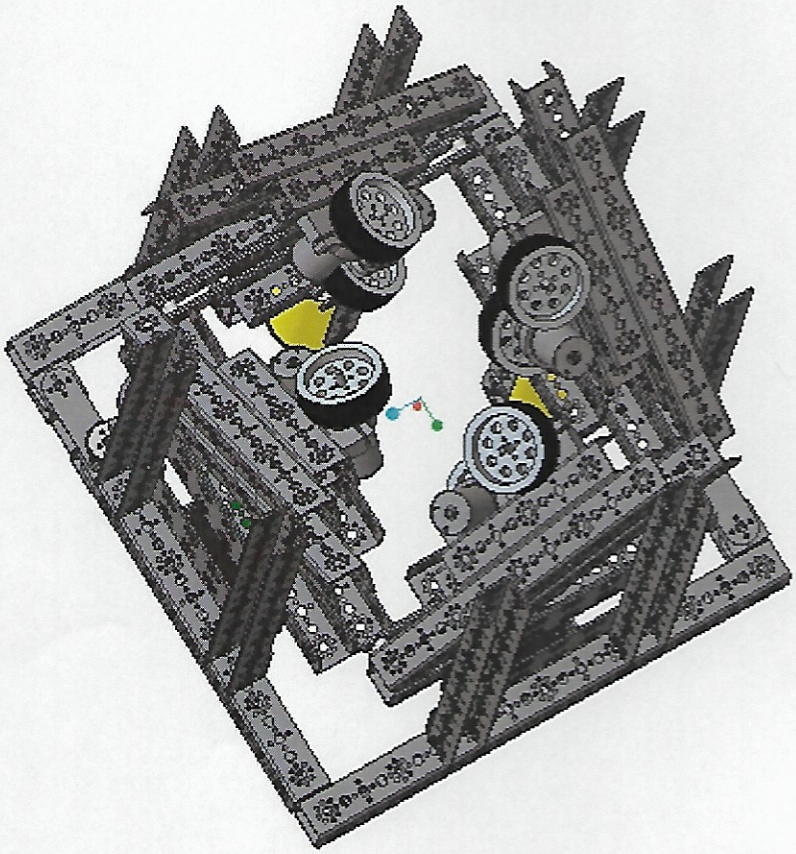


Final PTC Product (cont.)



Final PTC Product (cont.)





List of Design Considerations

No.	Consideration	Solution
1.	Distance of travel to reach 50 feet and back	To be determined in robot program
2.	How wrap around pole	Hinge-and-gate mechanism
3.	Open and close hinge	1 DC motor
4.	Latch for hinge-and-gate mechanism	Locked in position by DC motor
5.	Pole size consideration	Currently fits 5-inch-diameter pole
6.	Pole taper	Not addressed in current design; can be addressed by spring-loaded wheels
7.	Balance of robot on pole	Originally: only 1 wheel on each side Currently: 2 wheels on each side for better balance
8.	Spiral bands of paint	Angled wheels
9.	How to angle wheels	Place wheel base channels appropriately on "flower" of chassis channels
10.	How to hold spray cans	Channel platforms and flat plate holders
11.	How to press spray can buttons	Dual-servo levers
12.	How to prevent robot form slipping down pole	Weight of robot: not been tested Traction: High-traction wheels
13.	Battery and electronics	Not addressed in current PTC model
14.	Amount of paint required to paint entire pole	Not addressed
15.	Sharpness of paint band's edges	Currently not addressed; can be improved by adding cones on spray can