FIRST TECH CHALLENGE

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2023-2024 *FIRST*® Tech Challenge

Basic ‘Bot Guide for TETRIX-Part 2

Sponsor Thank You

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Revision History		
Revision	**Date**	**Description**
1	9/20/2023	Initial Release

Contents

Introduction

What is FIRST® Tech Challenge?

FIRST® Tech Challenge is a student-centered program that focuses on giving students a unique and stimulating experience. Each year, teams engage in a new game where they design, build, test, and program autonomous and driver operated robots that must perform a series of tasks. Participants and alumni of *FIRST* programs gain access to education and career discovery opportunities, connections to exclusive scholarships and employers, and a place in the *FIRST* community for life. To learn more about *FIRST*® Tech Challenge and other *FIRST*® Programs, visit www.firstinspires.org.

Gracious Professionalism®

FIRST® uses this term to describe our programs' intent.

Gracious Professionalism® is a way of doing things that encourages high-quality work, emphasizes the value of others, and respects individuals and the community.

Watch Dr. Woodie Flowers explain *Gracious Professionalism* in this short video.

Introduction to this Guide

About this Guide

The Basic 'Bot Guide is intended for teams looking for a step-by-step instructional guide on how to build a basic chassis and structure of the robot. Each season there is a new release of this guide, previously called the "Push Bot Guide", this version the **Basic 'Bot Guide for TETRIX Part 2** has been created to use 2023-2024 season's TETRIX kit of parts.

Parts

- TETRIX FTC Competition Set
  - Tools included with the TETRIX FTC Competition Set
- Electronics Modules and Sensors Set
- Control & Communication Set 1 or 2
  - (Optional) Only the tools included in the FTC Competition Set will be needed to build the chassis. The screws and nuts are a standard size and having more tools may allow more students to participate at the same time.
  - (Optional) A ruler is not needed to build this robot, but it is necessary to make sure that the robot is competition ready.

Tips and Tricks

- Organize and separate all of the parts you will need to build the armature before you get started.
- Keep extra parts in separate bags for use later or as replacements.
- Make sure that set screws are installed in every axle hub, motor hub, and axle collar.
- Refer to the legend provided in the Kit of Parts, if any parts are unfamiliar.
- Make sure that all assemblies are perpendicular (90° angles). It is hard to drive a crooked robot straight!
- The drive wheels are powered by two DC motors located on the back of the robot, which are relatively heavy. This weight is needed to help the wheels grip the surface better.
- Omni wheels should be located on the front of the robot, which allows the robot to turn more easily. The omni wheels' rollers slide sideways with very little friction.
- Unless otherwise noted, the top image in each step shows the necessary parts; the lower image shows the completed assembly.
- Place all completed sub-assemblies aside in a plastic container.

Computer Aided Design (CAD)

- The drawings in this document were generated using Creo Parametric Computer Aided Design (CAD) software.
  - By designing on the computer first with CAD, the design can be tested to ensure everything will work together before actual construction.
- The Creo software is available for free to FIRST teams for use in designing robots. The CAD drawings color code the screws to help identify them (see table below).

CAD Coloring Legend

Pitsco Part Number		Part	Color
39098		5/16" socket head cap screw	red
39094		keps nut	blue
39111		3/8" button head cap screw	green
39097		1/2" socket head cap screw	yellow
39195		motor mount screw	orange

Overview

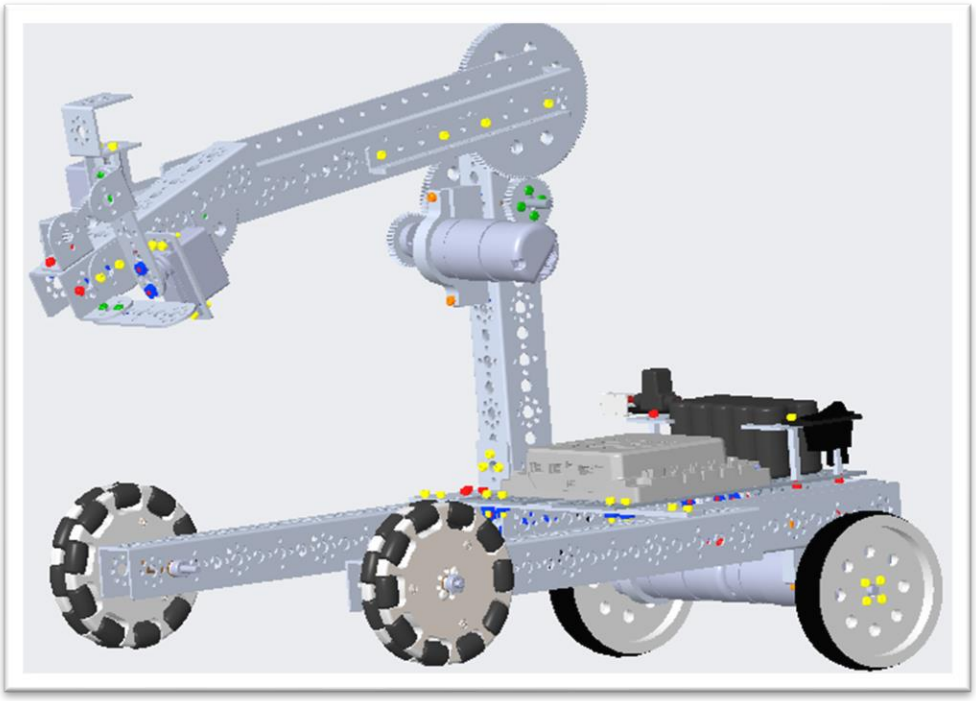

Figure 1- Front Left View

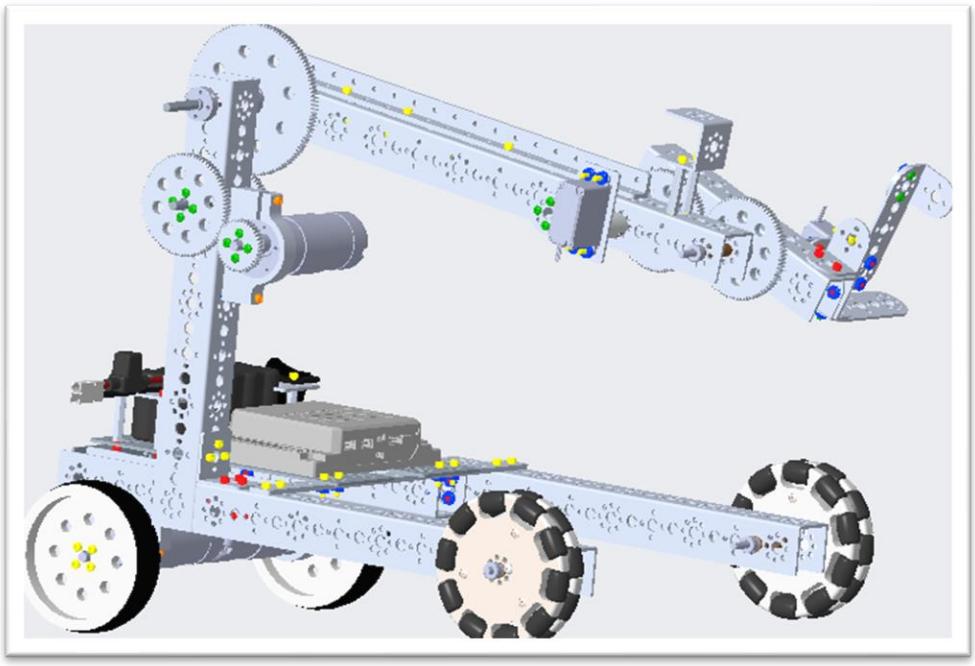

Figure 2- Front Right View

Armature

Step 1: Add the Armature Channel

Parts Needed:
39068 TETRIX MAX 288 mm Channel (1)
39098 Socket Head Cap Screw 6-32 x 5/16" (3)
39094 Kep Nut (3)

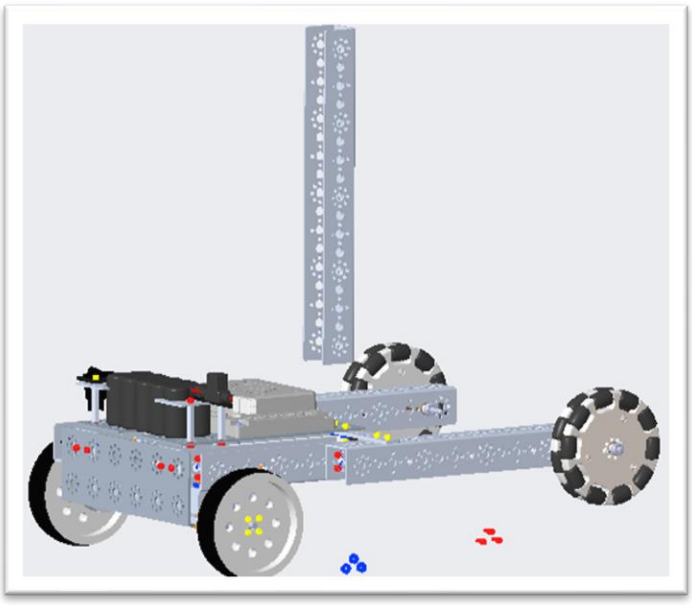

Figure 3- Unassembled view

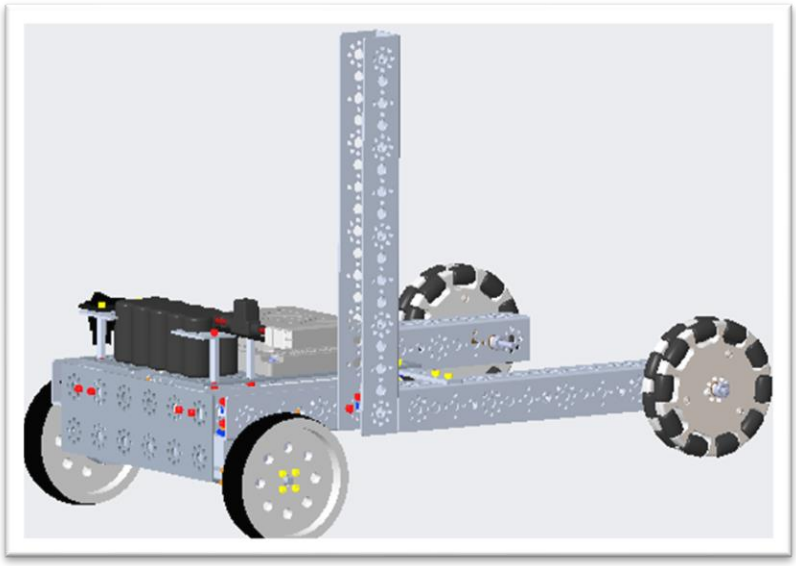

Figure 4- Assembled view

Step 2: Add Armature Channel Support

Parts Needed:
39281 TETRIX MAX Inside Corner Bracket (1)
39097 Socket Head Cap Screw 6-32 x 1/2" (3)
39098 Socket Head Cap Screw 6-32 x 5/16" (3)
39094 Kep Nut (6)

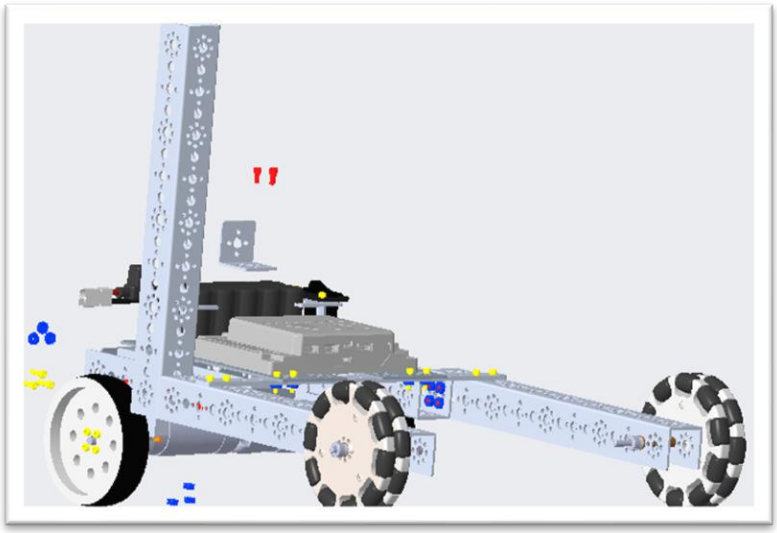

Figure 5- Unassembled view

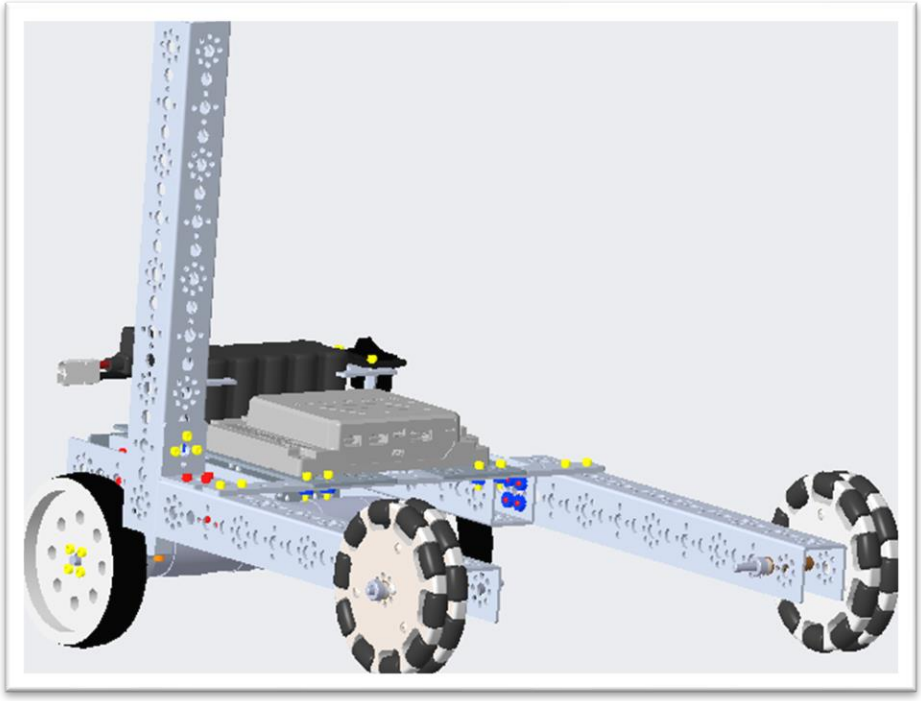

Figure 6- Assembled View

Step 3: Add Lower Gear Train

Parts Needed:

39111 Button Head Cap Screw 3/8" (8)
39086 TETRIX MAX Gear 80-Tooth (1)
39079 TETRIX MAX Motor Hub (2)
41665 TETRIX PRIME 6 mm Plastic Bushing Spacer (4)
40227 TETRIX PRIME 8 mm x 6 mm Bronze Bushing (2)
44708 TETRIX MAX 100 mm x 6 mm Axle (1)
39028 TETRIX MAX Gear 40-Tooth (1)

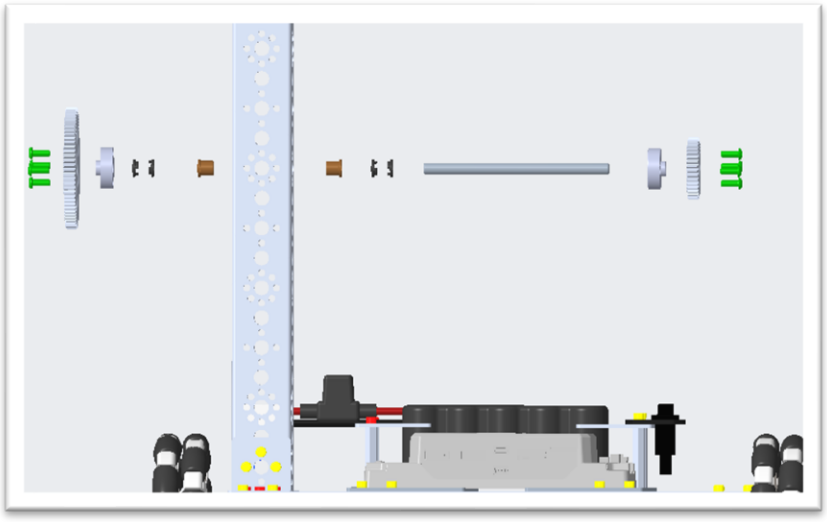

Figure 7- Unassembled view

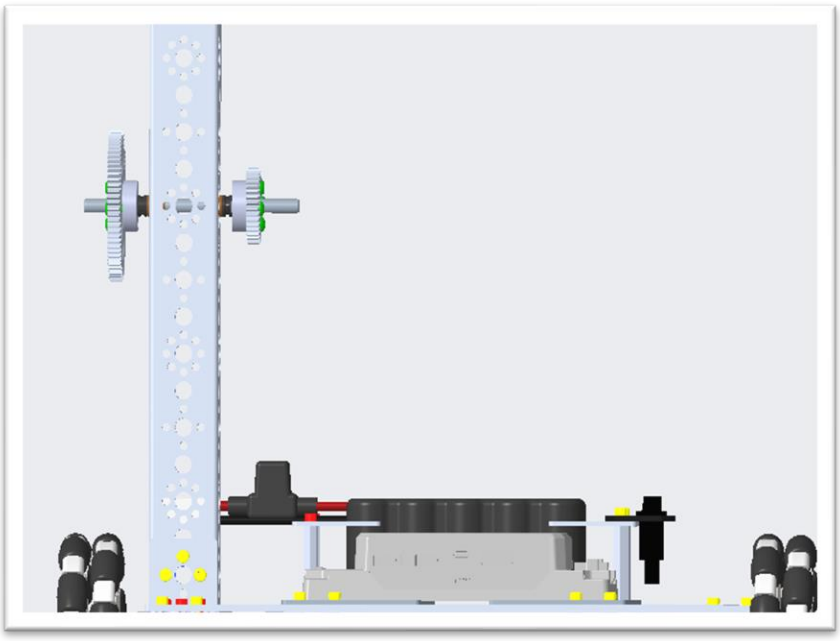

Figure 8- Assembled View

Step 4: Add Upper Gear Train

Parts Needed:

39079 TETRIX MAX Motor Hub (2)
44708 TETRIX MAX 100 mm x 6 mm Axle (1)
41665 TETRIX PRIME 6 mm Plastic Bushing Spacer (4)
40227 TETRIX PRIME 8 mm x 6 mm Bronze Bushing (2)
39085 TETRIX MAX Gear 120-Tooth (1)
39066 TETRIX MAX 96 mm Channel (1)
39097 Socket Head Cap Screw 6-32 x 1/2" (4)

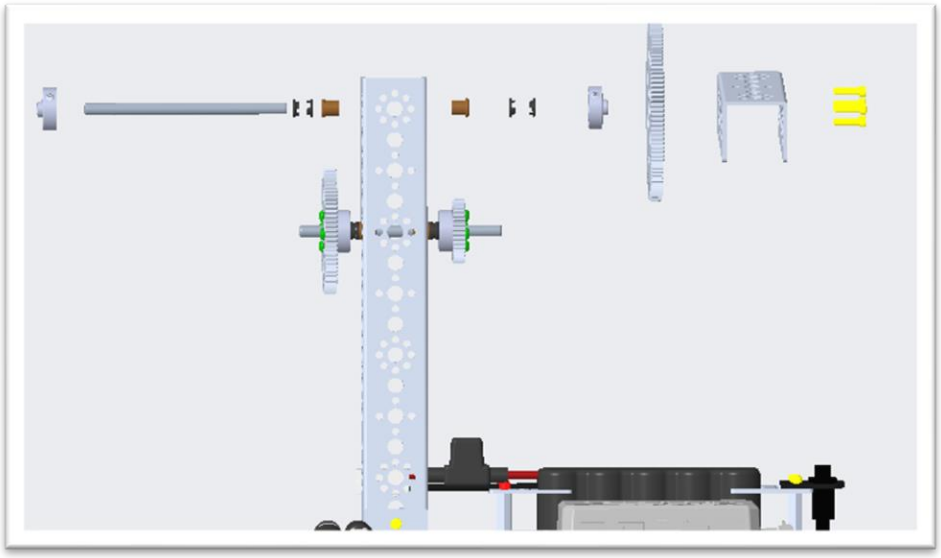

Figure 9- Unassembled view

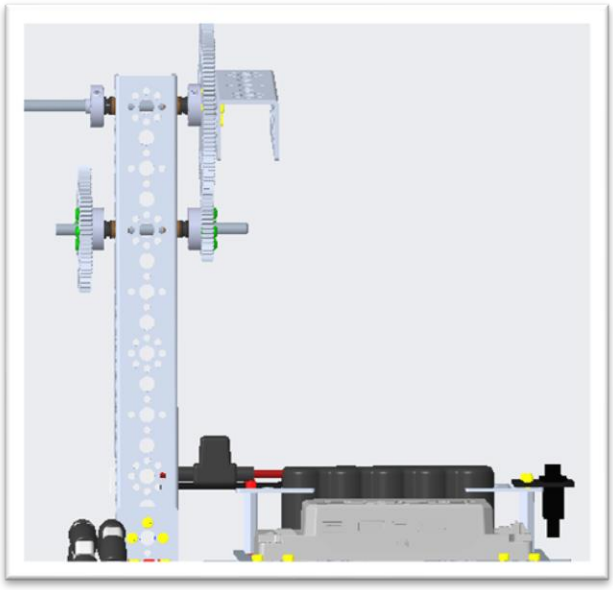

Figure 10- Assembled view

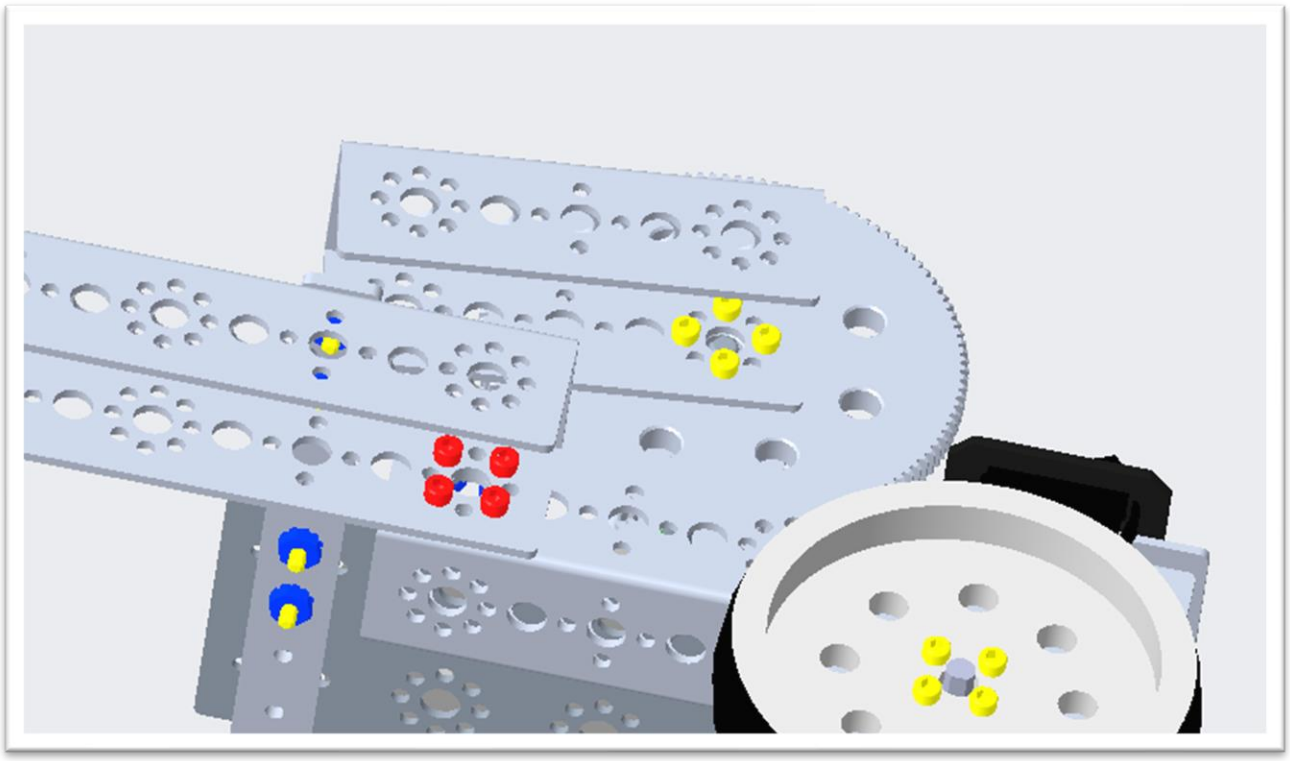

Figure 11- Detail view

Helpful Hints

- The view is from the bottom of the robot, so the support channel cannot be seen.
- This detailed image shows the placement of the four 1/2" screws.

Step 5: Add Armature Motor Mount

Parts Needed:
39089 TETRIX MAX Motor Mount (1)
With Included Screws (2)
39094 Kep Nut (2)

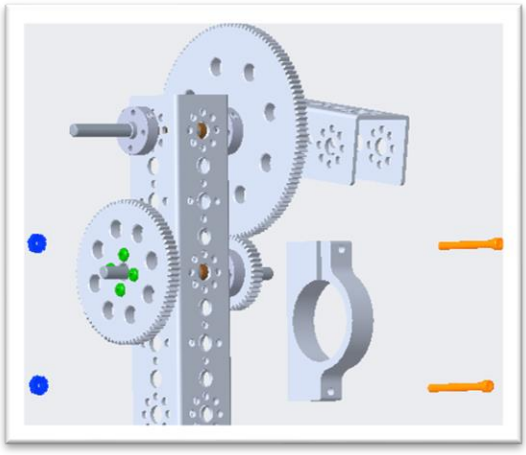

Figure 12- Unassembled view

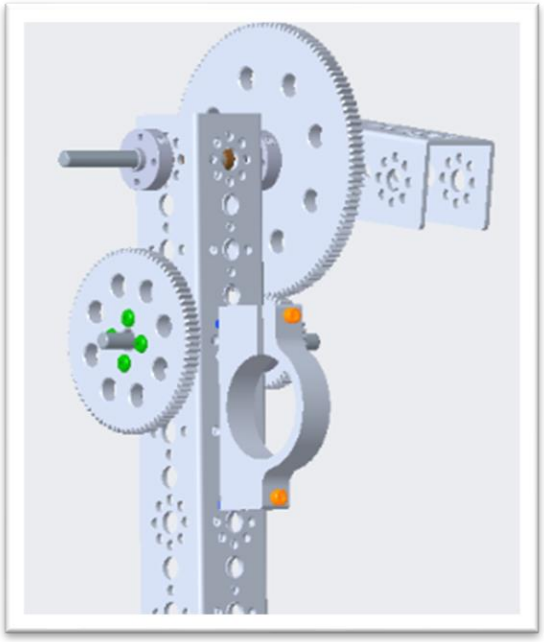

Figure 13- Assembled view

Helpful Hints

- Tighten the lower screw.
- Leave the upper screw slightly loose, so the motor can be inserted in a later step.

Step 6: Add Armature Motor and Gears

Parts Needed:
39111 Button Head Cap Screw 3/8" (4)
39028 TETRIX MAX Gear 40-Tooth (1)
39079 TETRIX MAX Motor Hub (1)
44260 TETRIX MAX TorqueNADO® Motor (1)

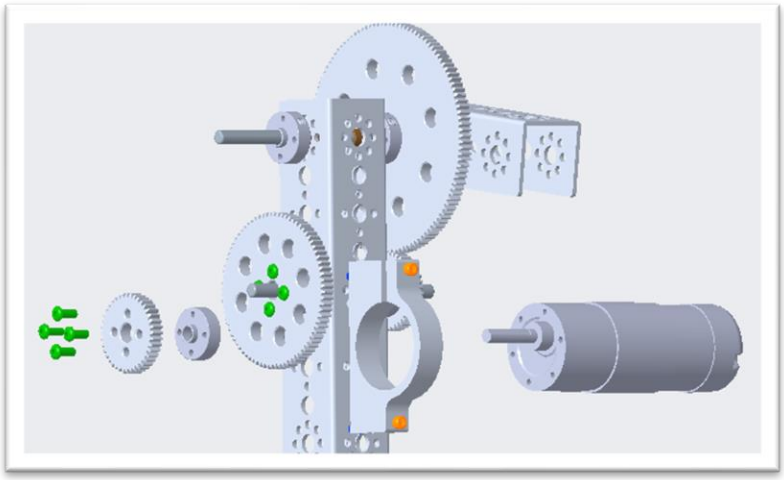

Figure 14- Unassembled View

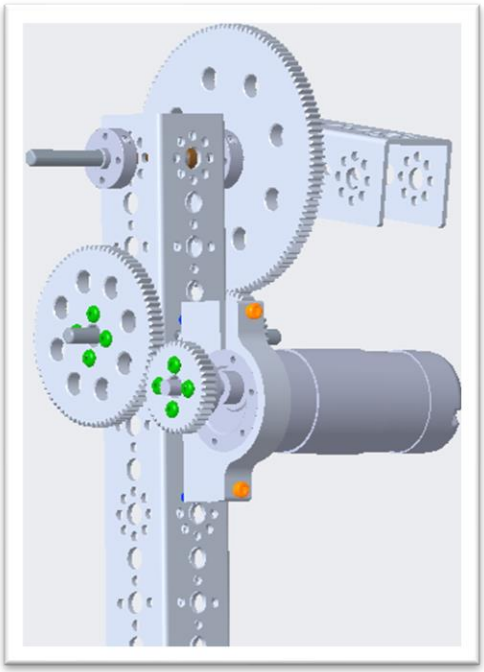

Figure 15- Assembled view

Helpful Hint

- Rotate the motor so the gears mesh; not too tight or the gears will bind; not too loose or they will skip.

Step 7: Add Channel-to-Channel Support

Parts Needed:
39097 Socket Head Cap Screw 6-32 x 1/2" (4)
39094 Kep Nut (4)
39072 TETRIX MAX 144 mm Angle (1)
39071 TETRIX MAX 288 mm Angle (1)

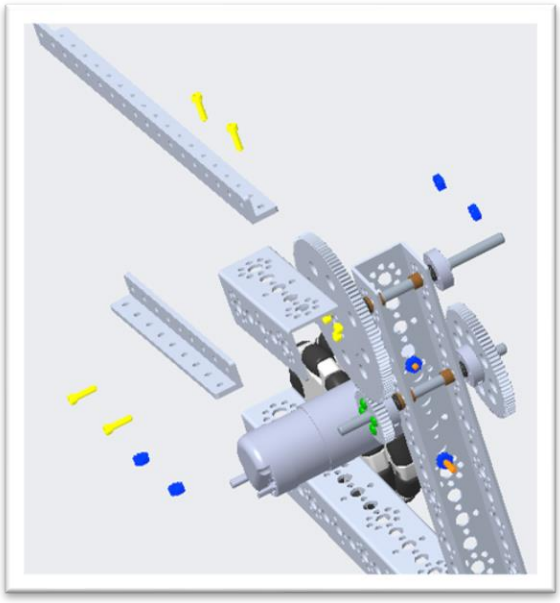

Figure 16- Unassembled view

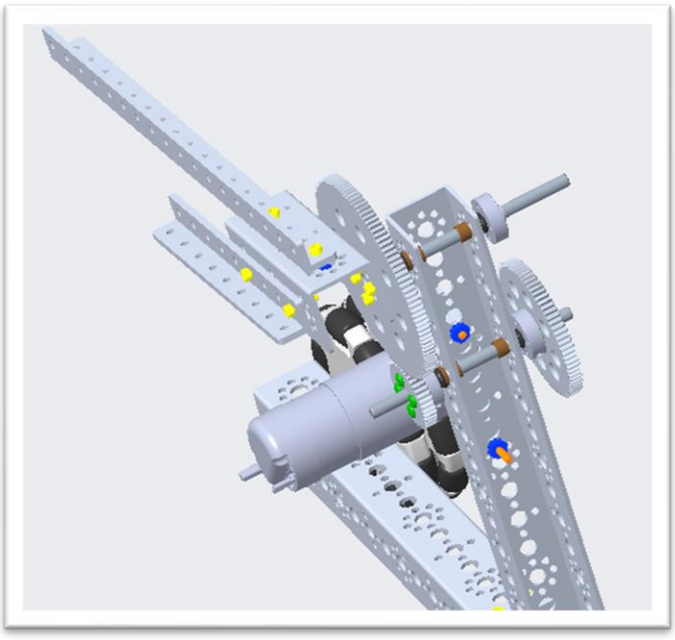

Figure 17- Assembled view

Step 8: Add Extension Channel to Channe l Supports

Parts Needed:
39068 TETRIX MAX 288 mm Channel (1)
39097 Socket Head Cap Screw 6-32 x 1/2" (5)
39094 Kep Nut (5)

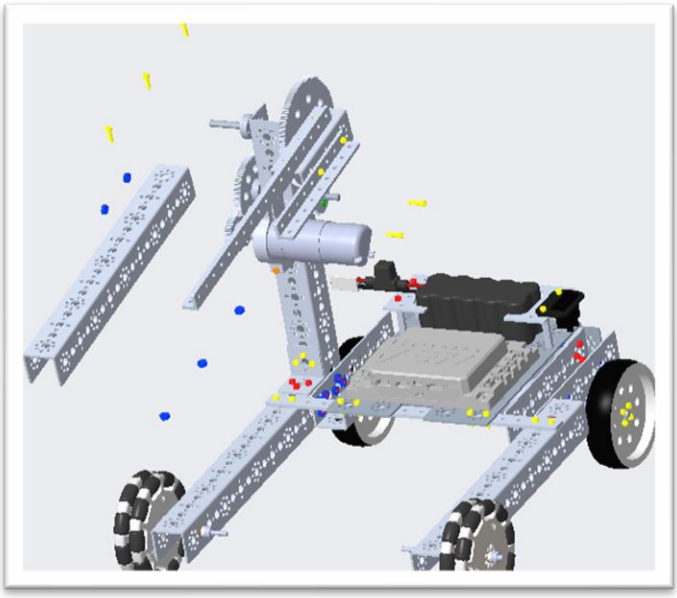

Figure 18- Unassembled view

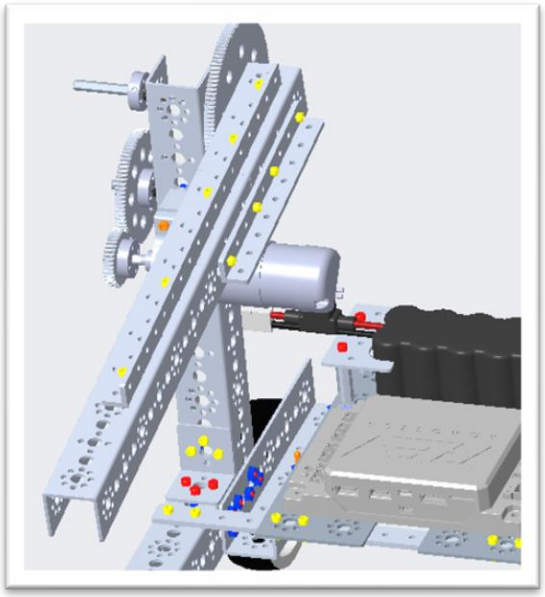

Figure 19- Assembled view

Step 9: Add First Servo Support to Extension Channel

Parts Needed:

39098 Socket Head Cap Screw 6-32 x 5/16" (4)
39111 Button Head Cap Screw 3/8" (4)
41789 TETRIX MAX Standard Servo Mounting Kit (1)
With Included Plate (1)
With Included Standoffs (4)

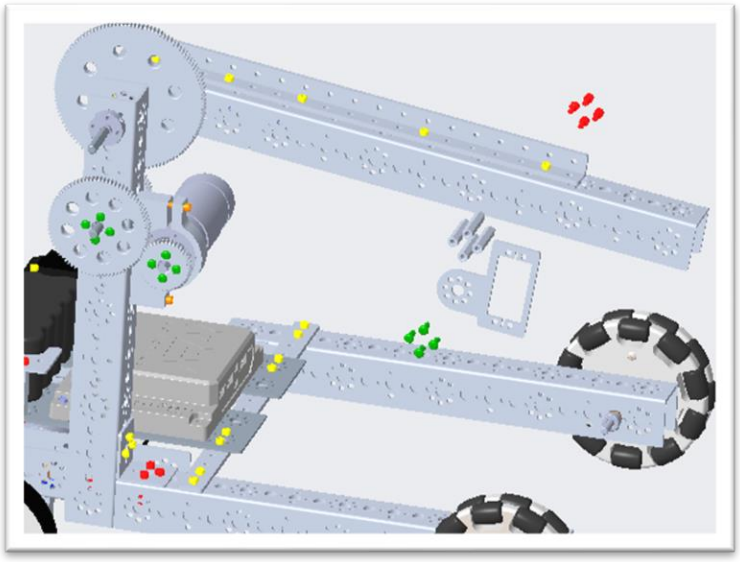

Figure 20- Unassembled view

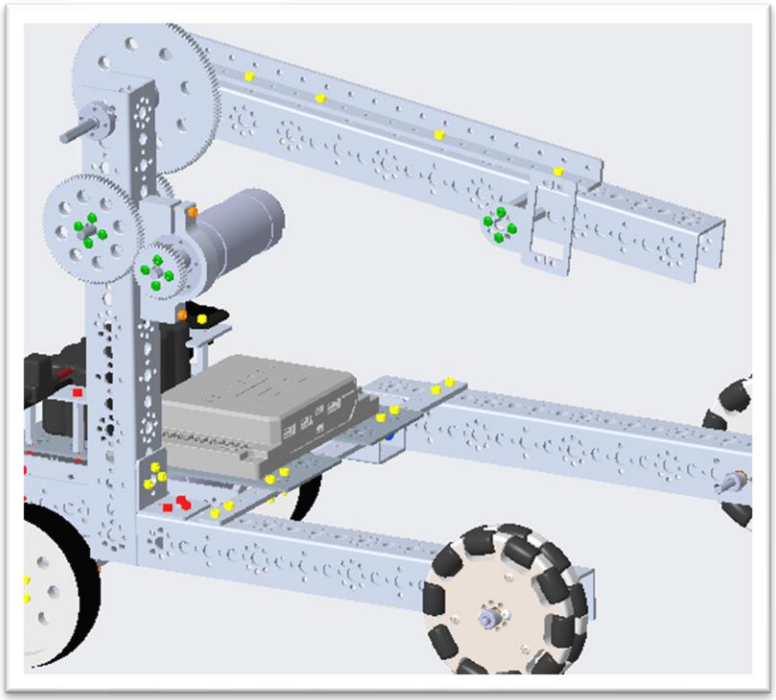

Figure 21- Assembled view

Step 10: Add First Servo and Servo Gear

Parts Needed:

41789 TETRIX MAX Standard Servo Mounting Kit (remainder from previous step)
With Included Motor (1)
With Included Servo to Shaft Coupler (1)
With Included Bronze Bushing (2)
With Included Axle (1)
39172 TETRIX MAX Axle Hub (1)
39086 TETRIX MAX Gear 80-Tooth (1)
39097 Socket Head Cap Screw 6-32 x 1/2" (4)
39100 TETRIX MAX Axle Spacer 1/8" (1)

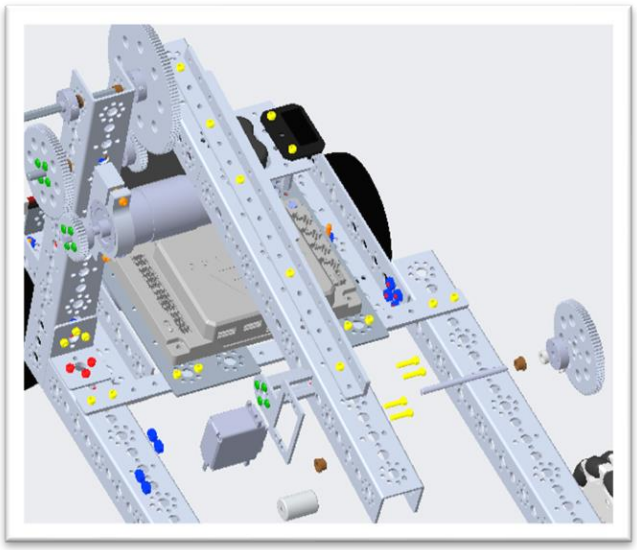

Figure 22- Unassembled View

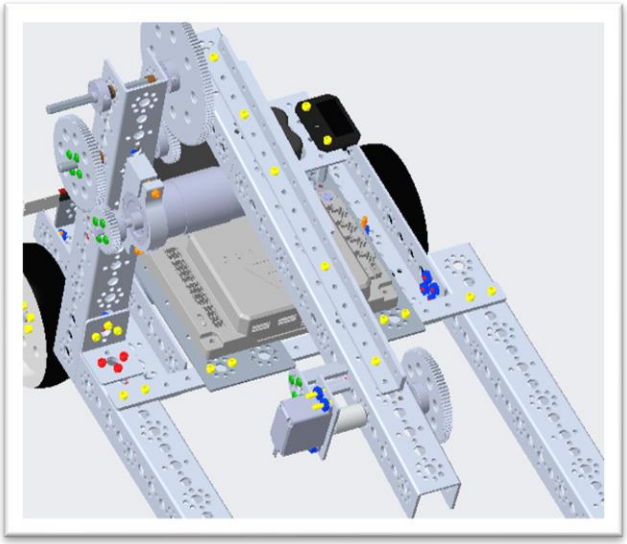

Figure 23- Assembled View from below the robot

Step 11: Add First Servo Gear Train

Parts Needed:

39088 TETRIX MAX 100 mm Axle (1)
39092 TETRIX MAX Axle Set Collar (1)
39091 TETRIX MAX Bronze Bushing (2)
39100 TETRIX MAX Axle Spacer 1/8" (1)
39172 TETRIX MAX Axle Hub (1)
39086 TETRIX MAX Gear 80-Tooth (1)
39387 TETRIX MAX Flat 2mm Spacer (1)
39067 TETRIX MAX 160 mm Channel (1)
39097 Socket Head Cap Screw 6-32 x 1/2" (2)

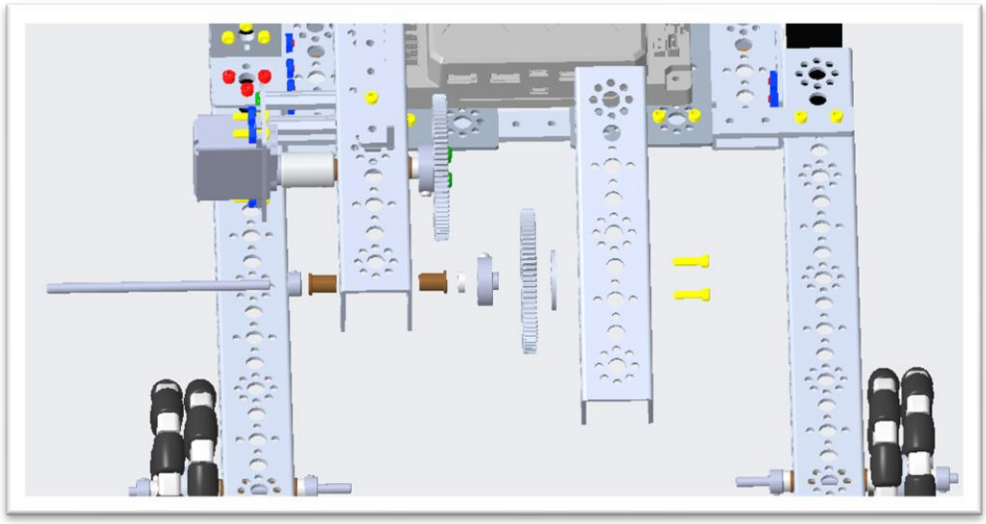

Figure 24- Unassembled view

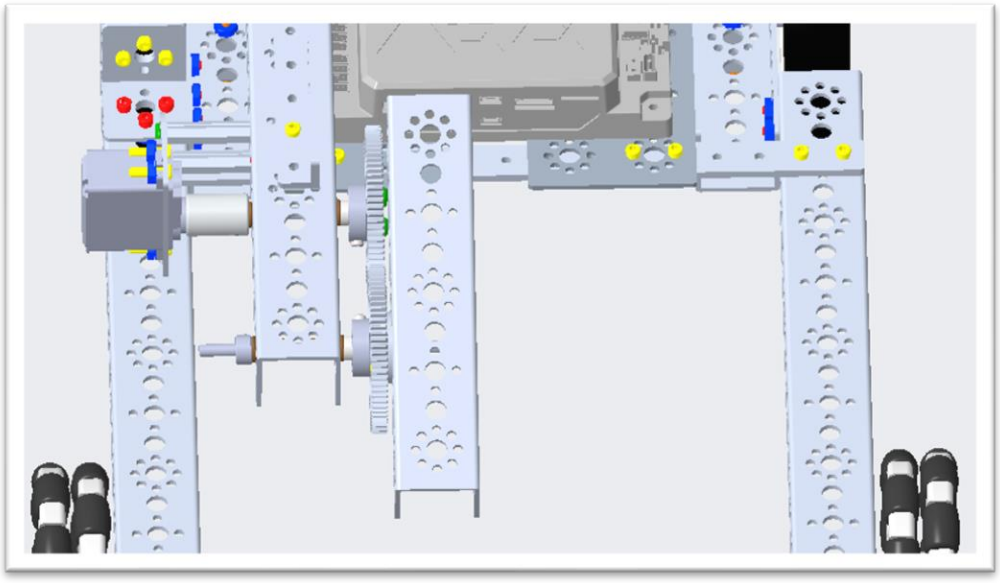

Figure 25- Assembled View

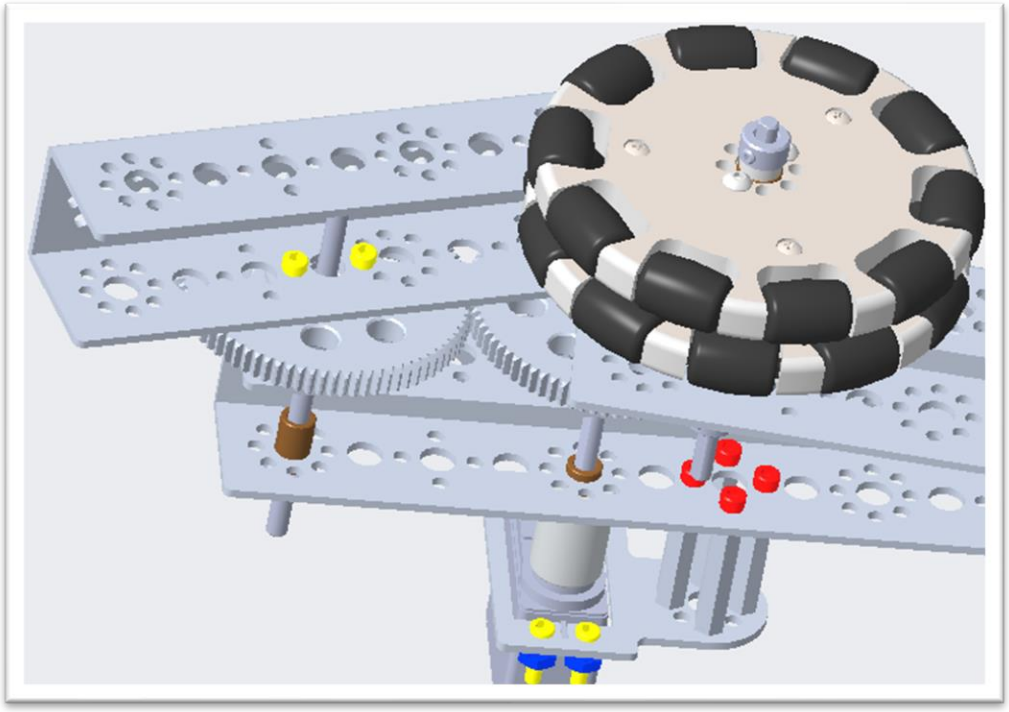

Figure 26- Detail View

Helpful Hints

- The view is from the bottom of the robot, so the full 160 mm channel cannot be seen.
- This detailed image shows the placement of the two 1/2" screws.

Step 12: Add First L Bracket

Parts Needed:
39062 TETRIX MAX L Bracket (1)
39098 Socket Head Cap Screw 6-32 x 5/16" (2)
39094 Kep Nut (2)

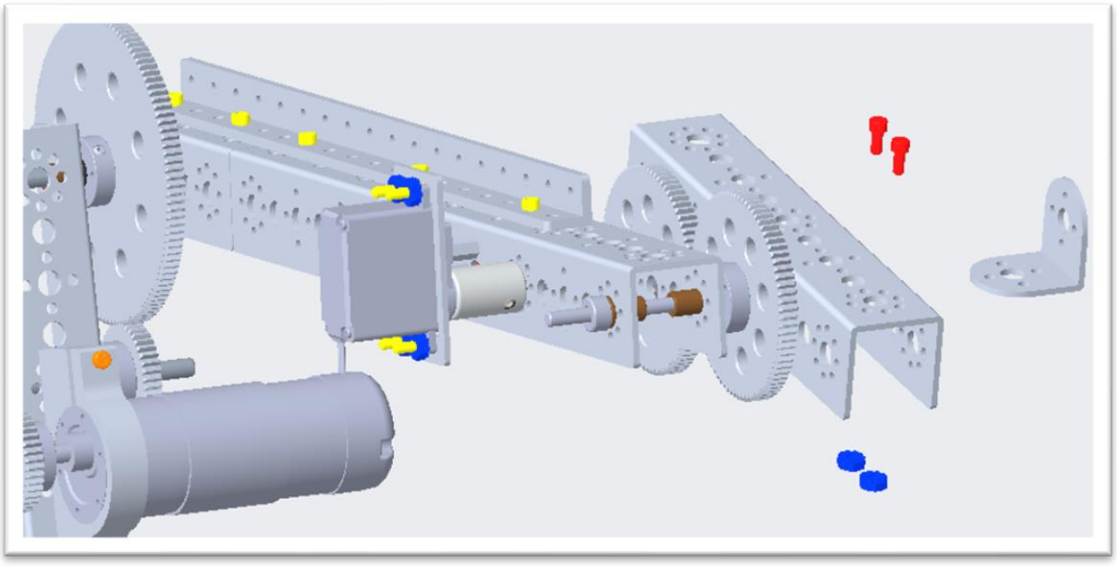

Figure 27- Unassembled view

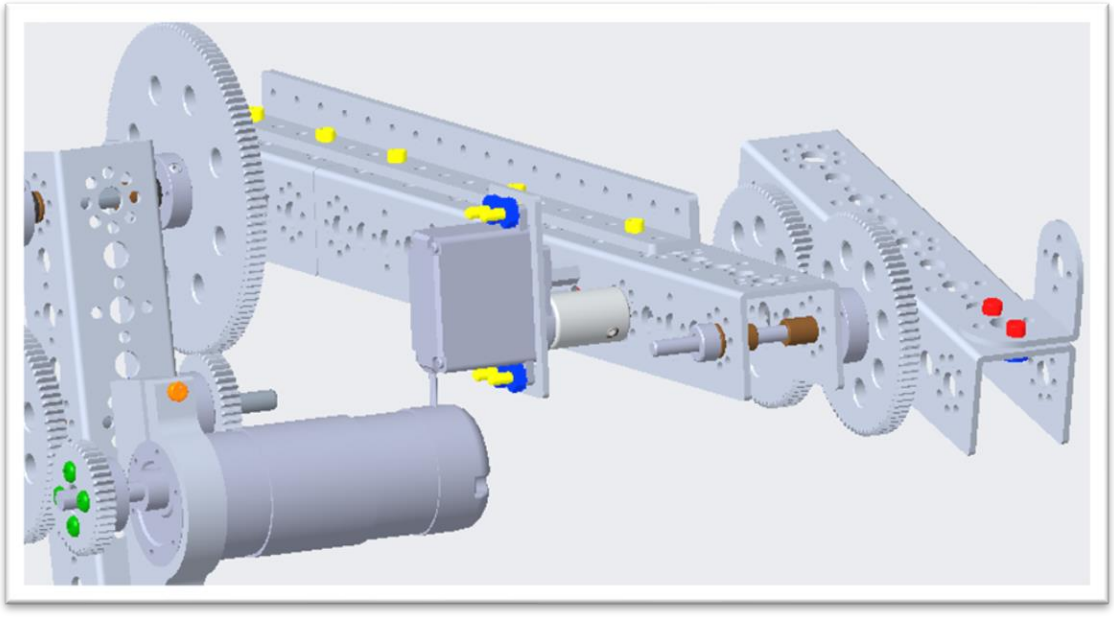

Figure 28- Assembled view

Step 13: Add Second and Third L Brackets

Parts Needed:
39062 TETRIX MAX L Bracket (2)
39098 Socket Head Cap Screw 6-32 x 5/16" (1)
39097 Socket Head Cap Screw 6-32 x 1/2" (2)
39094 Kep Nut (3)

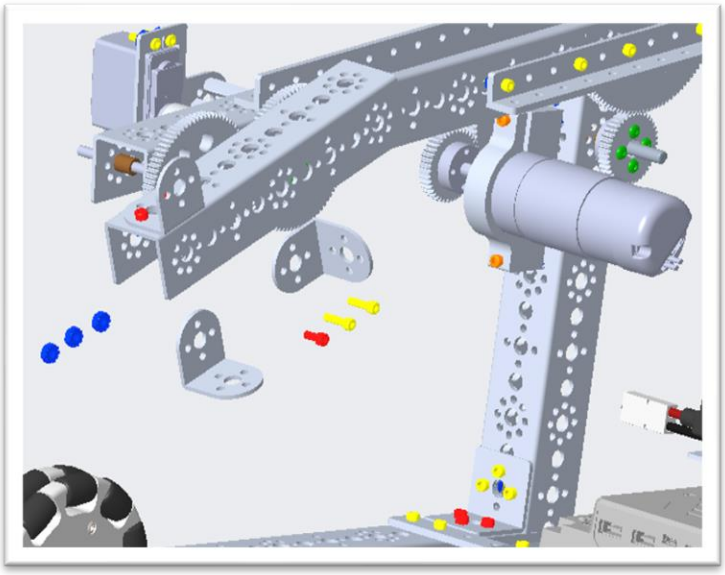

Figure 29- Unassembled view

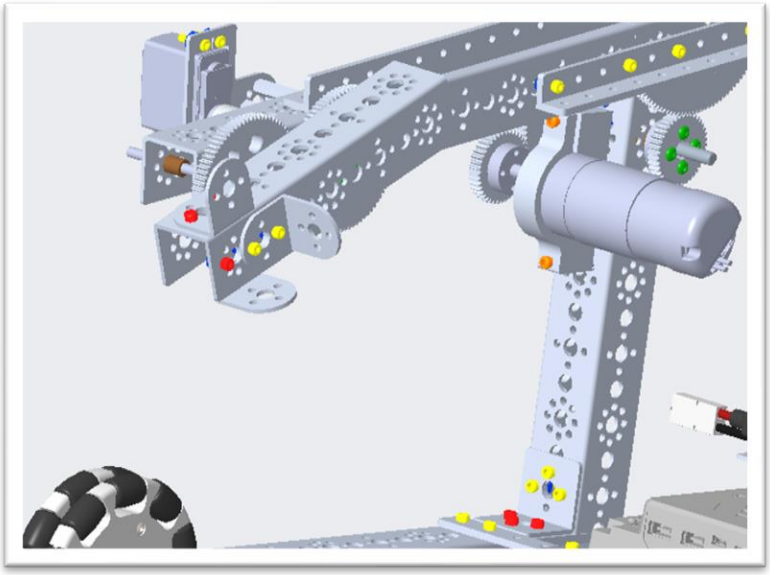

Figure 30- Assembled view

Step 14: Add Flat Bracket

Parts Needed:
39273 TETRIX MAX Flat 96 mm x 27 mm (1)
39111 Button Head Cap Screw 3/8" (2)
39094 Kep Nut (2)

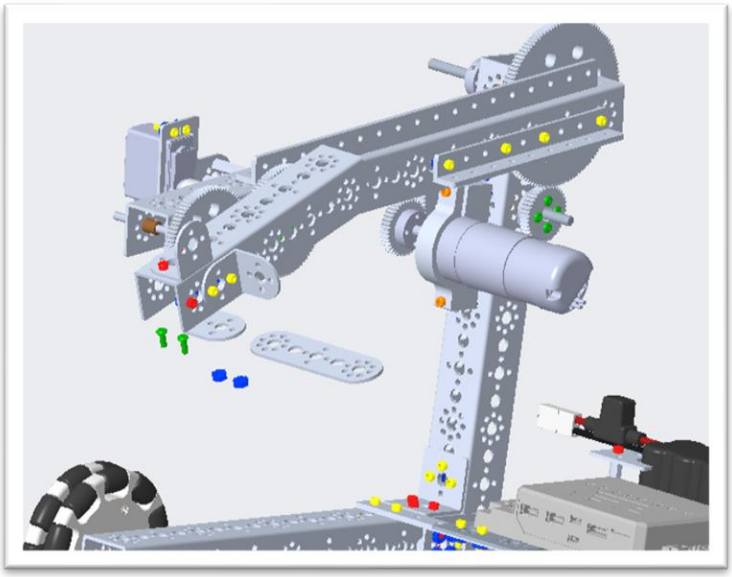

Figure 31- Unassembled view

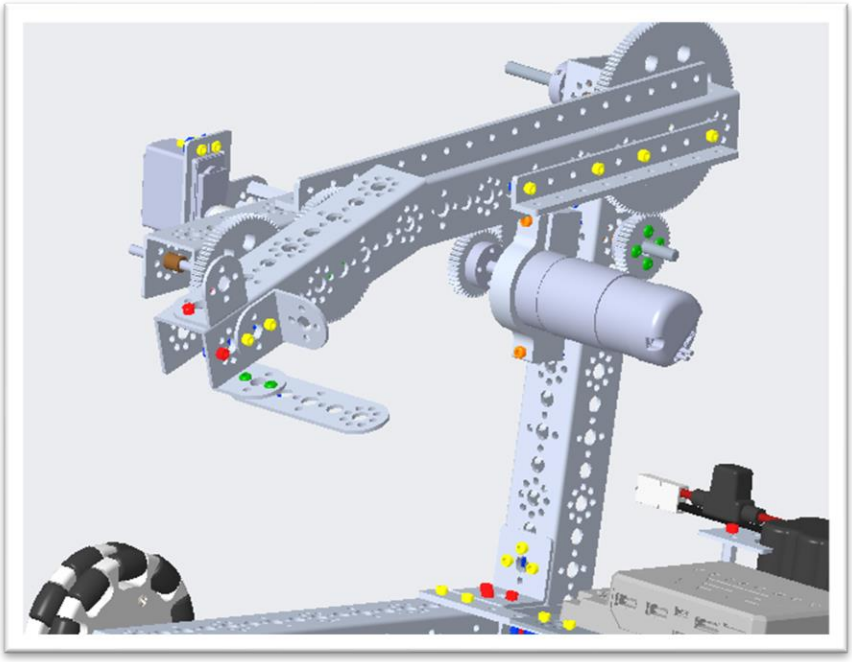

Figure 32- Assembled view

Step 15: Add Second Servo Support

Parts Needed:
41789 TETRIX MAX Standard Servo Mounting Kit (1)
With Included Plate (1)
39098 Socket Head Cap Screw 6-32 x 5/16" (2)
39094 Kep Nut (2)

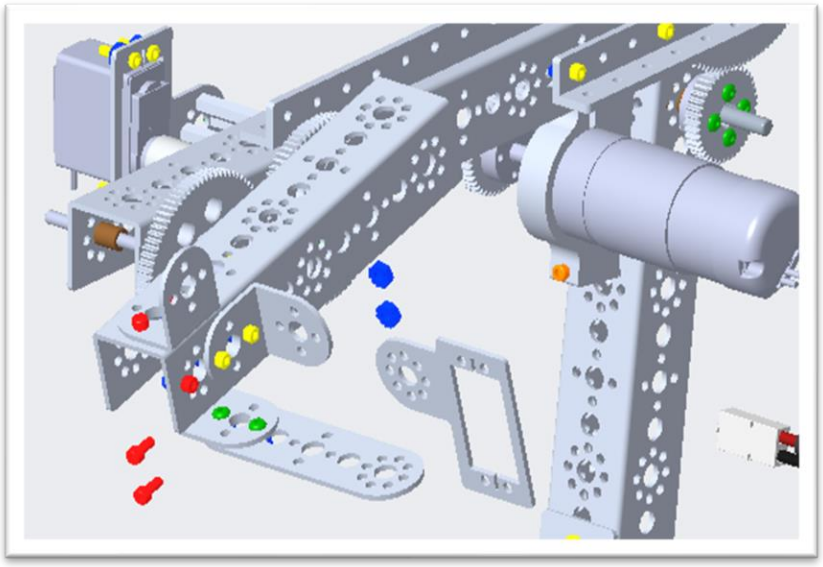

Figure 33- Unassembled view

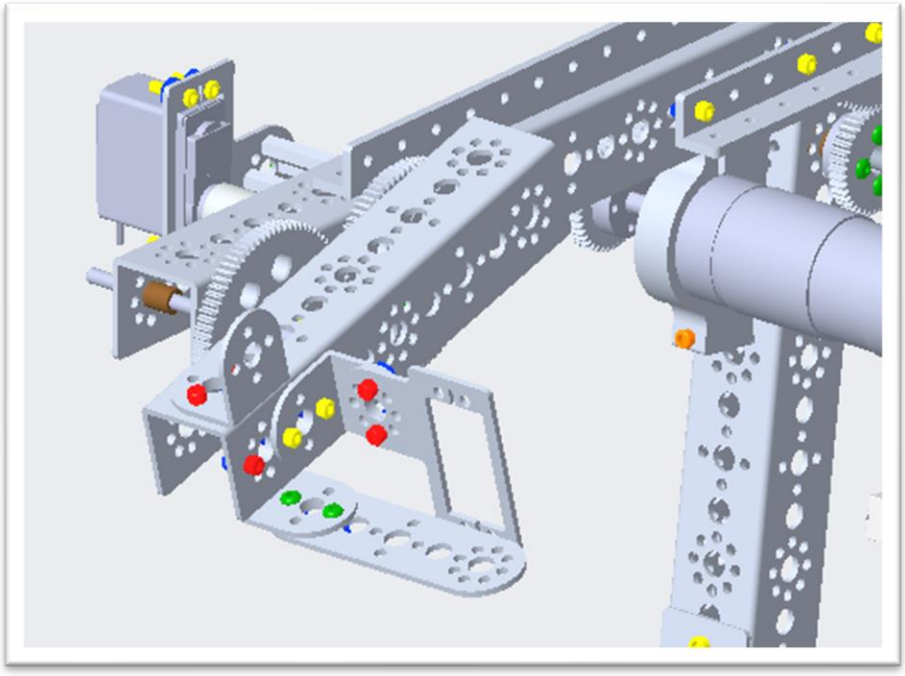

Figure 34- Assembled view

Step 16: Add Second Servo

Parts Needed:

41789 TETRIX MAX Standard Servo Mounting Kit (remainder from previous step)
With Included Motor (1)
39097 Socket Head Cap Screw 6-32 x 1/2" (4)
39094 Kep Nut (4)

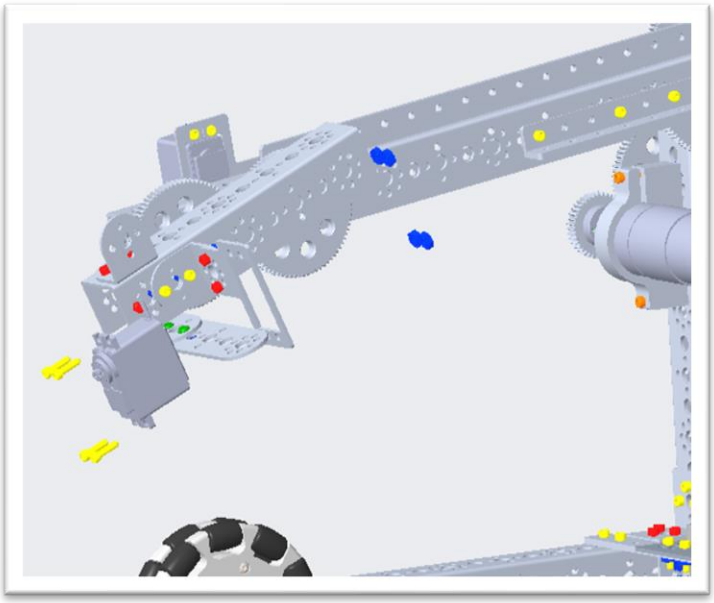

Figure 35-Unassembled view

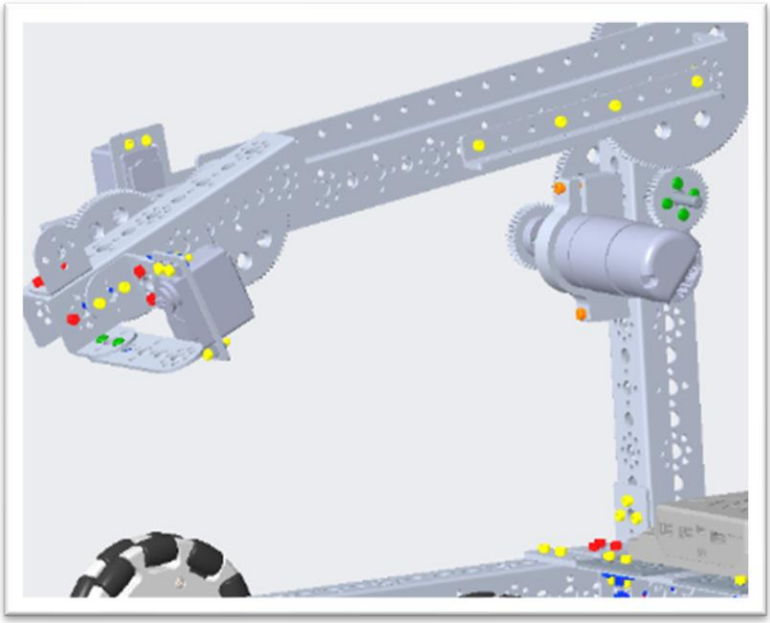

Figure 36- Assembled view

Step 17: Add Second Servo Assembly

Parts Needed:

41789 TETRIX MAX Standard Servo Mounting Kit (remainder from previous step)
With Included Horn (1)
39273 TETRIX MAX Flat 96 mm x 27 mm (1)
39062 TETRIX MAX L Bracket (1)
39098 Socket Head Cap Screw 6-32 x 5/16" (2)
39111 Button Head Cap Screw 3/8" (2)
39094 Kep Nut (4)

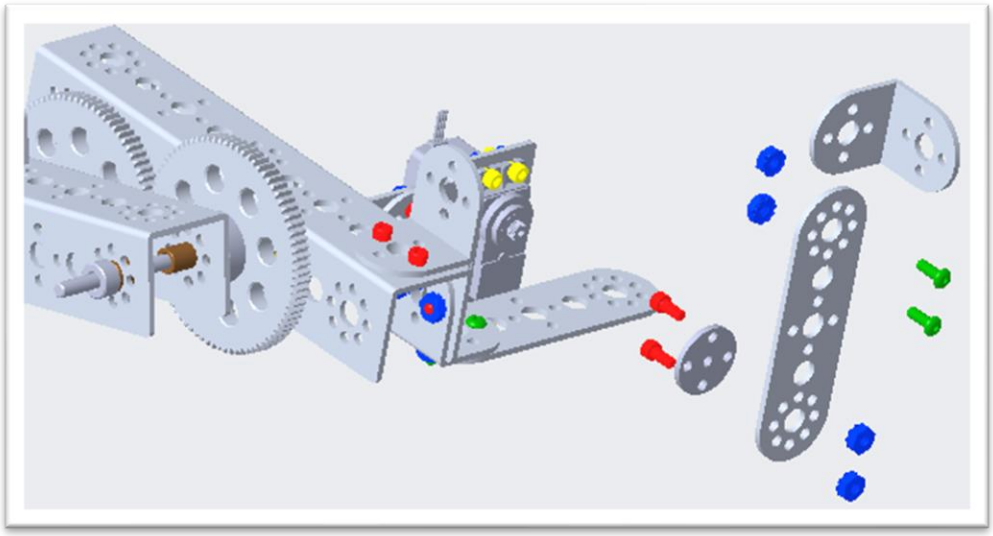

Figure 37- Unassembled view

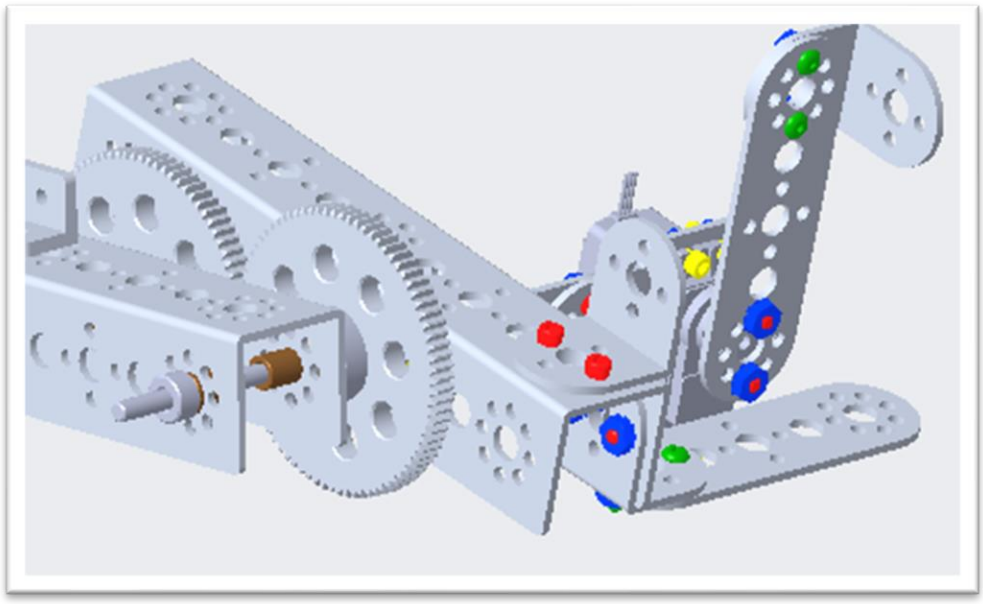

Figure 38- Assembled view

Step 18: Add Channel and Stand Offs

Parts Needed:
39065 TETRIX MAX 32 mm Channel (1)
39107 TETRIX Stand-Off Post 6-32 x 32 mm (2)
39097 Socket Head Cap Screw 6-32 x 1/2" (4)

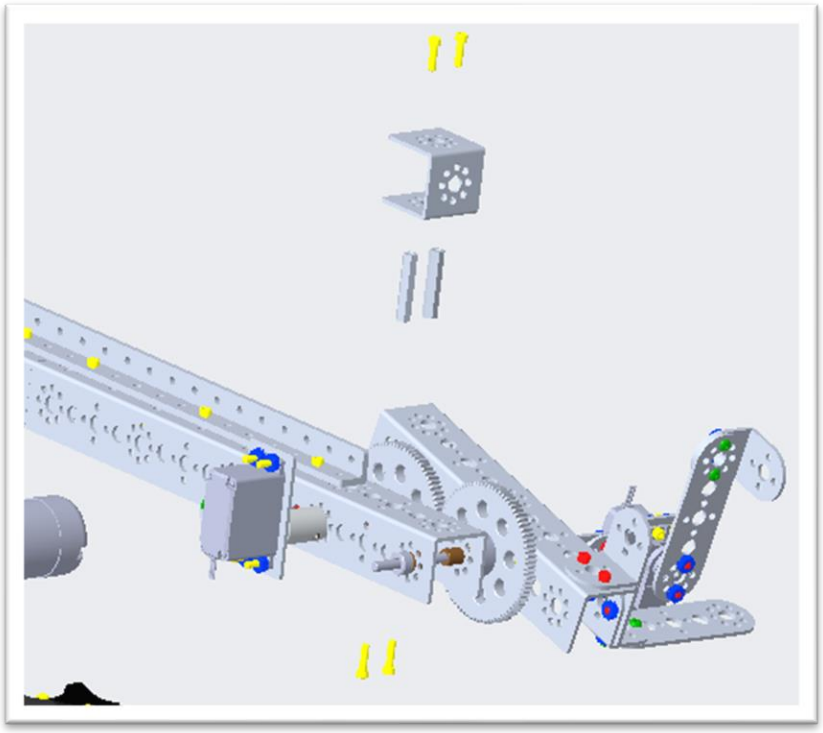

Figure 39- Unassembled view

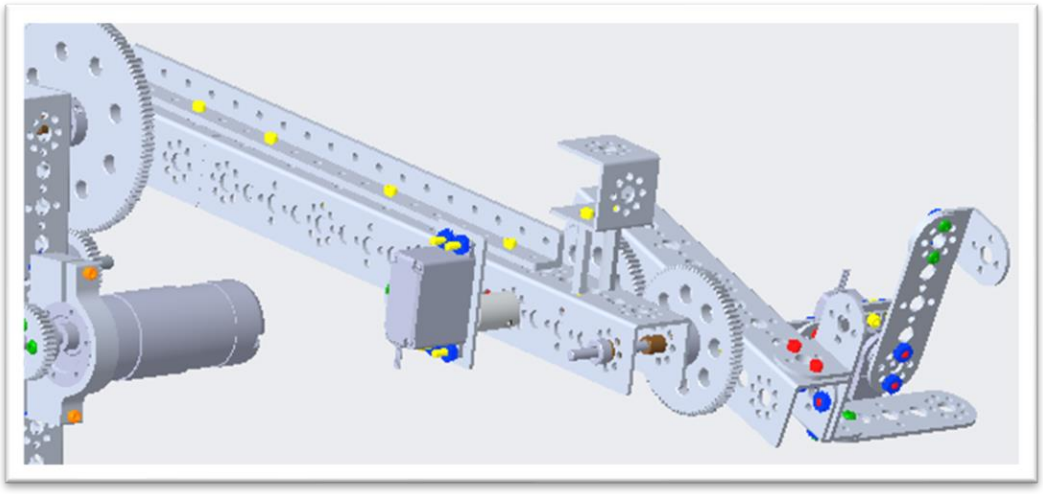

Figure 40- Assembled view

Helpful Hint

- This channel can be used to suspend the robot during end game.

Wiring

Step 19: Add Arm Motor and Servo Power Cables

Parts Needed:

REV-31-1381 JST to Anderson Power Pole Cable (1)

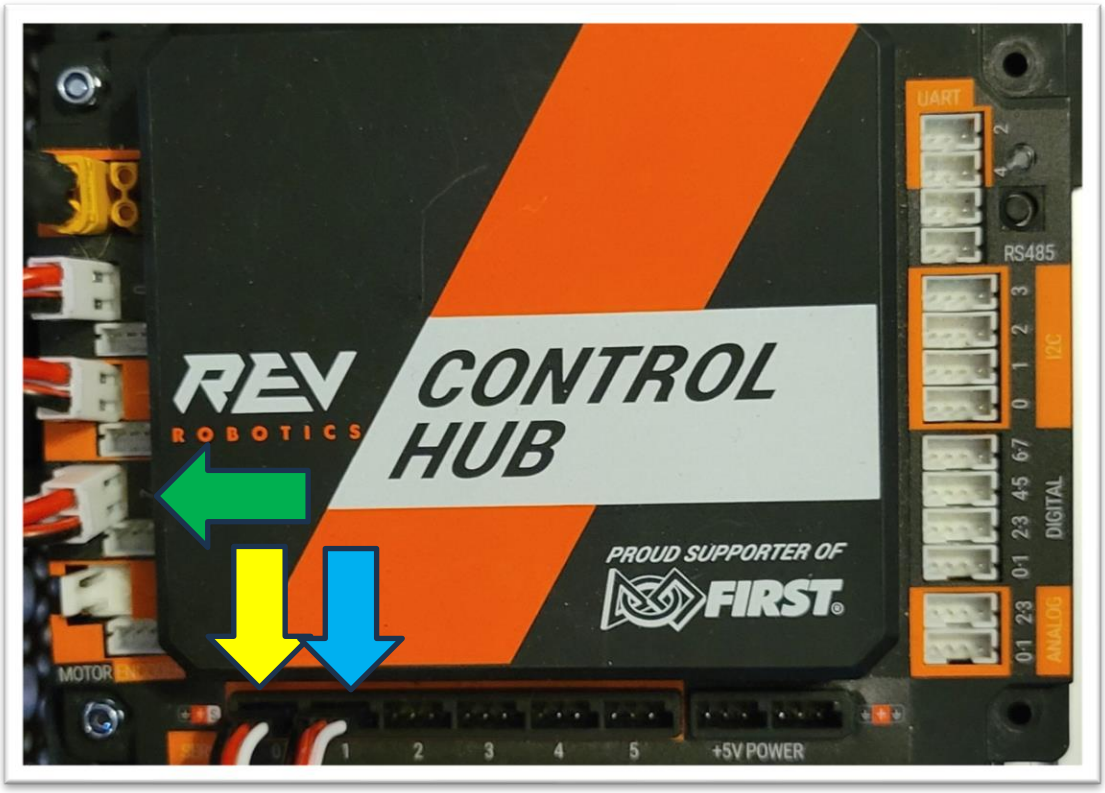

Figure 41- Control Hub

Helpful Hints

- Plug the arm motor into port 2 shown by the green arrow.
- Plug the first servo into port 1 shown by the yellow arrow.
- Plug the second servo into port 0 shown by the blue arrow.

Step 20: Adjust Servos

Tools Needed:
None

Helpful Hints

- The arm on the second servo needs to be adjusted so that it holds the pixel firmly, but not with so much force that it pops out.
- After adjustment, use the screw included with the servo kit to secure the horn onto the servo.
- The first servo needs to be adjusted so that the gripper assembly is flush to the floor when the arm is down. This allows it to be rotated to a 30 degree angle when the arm is behind the robot for scoring.

Final Steps

What's Next?

- Make sure that axle hub, motor hub, and axle collar set screws are installed, so that the screw is on the flat side of the axle, which will prevent assemblies from spinning on the axle.
- You have now constructed the armature of your Basic 'Bot, however, programming will be needed to make the armature functional.
- Testing should be done to determine whether anything needs to be changed or optimized for the season's game rules. Testing will also show whether more cables need to be secured or re-routed.
- Check the game rules for all the applicable stickers.
- Make sure to also go over the robot checklists:
    - Robot Self-Inspection Checklist
    - Robot Reliability Checklist

Resources

Visit the *FIRST* website for Programming Resources, Robot Building Resources, more instructions and game rules.

Appendix A – Resources

Game Forum Q&A

https://ftc-qa.firstinspires.org/

Anyone may view questions and answers within the *FIRST*® Tech Challenge game Q&A forum without a password. To submit a new question, you must have a unique Q&A system user name and password for your team.

Volunteer Forum

Volunteers can request access to role specific volunteer forums by emailing FTCTrainingSupport@firstinspires.org. You will receive access to the forum thread specific to your role.

FIRST Tech Challenge Game Manuals

Part 1 and 2 - https://www.firstinspires.org/resource-library/ftc/game-and-season-info

FIRST Headquarters Pre-Event Support

Phone: 603-666-3906
Mon – Fri
8:30am – 5:00pm
Email: Firsttechchallenge@firstinspires.org

FIRST Websites

FIRST homepage – www.firstinspires.org

FIRST Tech Challenge Page – For everything *FIRST* Tech Challenge.

FIRST Tech Challenge Volunteer Resources – To access public volunteer manuals.

FIRST Tech Challenge Event Schedule – Find *FIRST* Tech Challenge events in your area.

FIRST Tech Challenge Social Media

FIRST Tech Challenge Twitter Feed - If you are on Twitter, follow the *FIRST* Tech Challenge Twitter feed for news updates.

FIRST Tech Challenge Facebook page - If you are on Facebook, follow the *FIRST* Tech Challenge page for news updates.

FIRST Tech Challenge YouTube Channel – Contains training videos, game animations, news clips, and more.

FIRST Tech Challenge Blog – Weekly articles for the *FIRST* Tech Challenge community, including outstanding volunteer recognition!

FIRST Tech Challenge Team Email Blasts – contain the most recent *FIRST* Tech Challenge news for teams.

Feedback

We strive to create support materials that are the best they can be. If you have feedback about this manual, please email firsttechchallenge@firstinspires.org. Thank you!