PM2

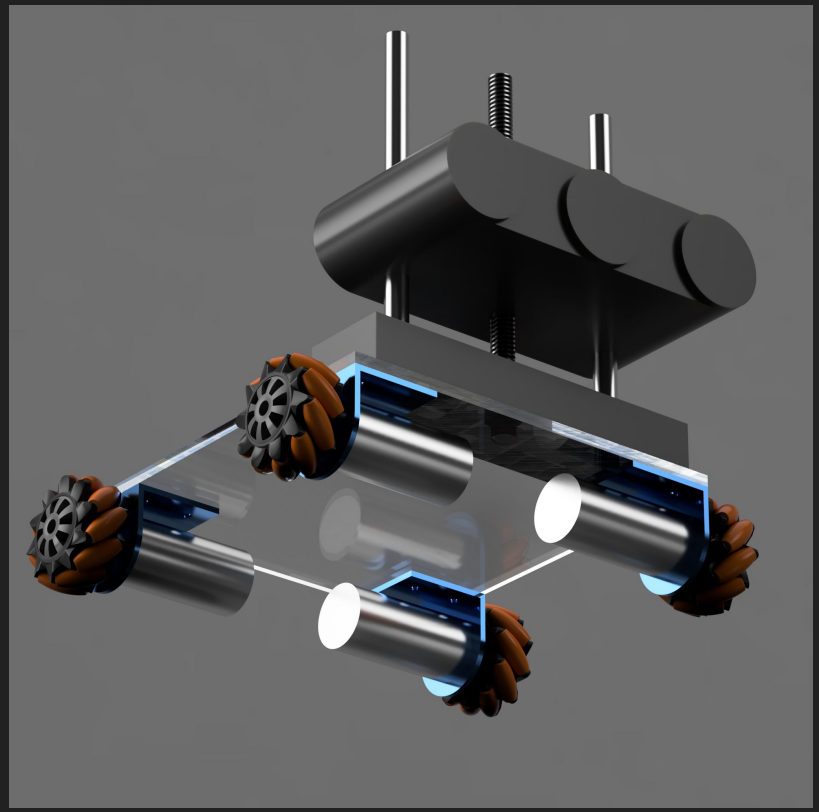
Kin, Andrew, Derek, Hyrum

Concept 1 - Lead Screw

Codename: “Triclops”

Kin

Concept 1 - CAD



Concept 1 - Overview

The robot uses mecanum wheels to move with full planar motion.

The robot picks up and places blocks using electromagnets which are mounted to an elevating platform. The platform is driven up and down using a lead screw.

The elevating platform is able to receive blocks at the reloader height and place them on the sides or top of the chassis. The platform is extended so that blocks can still be placed on top even if the side spots are occupied.

Concept 1 - Hardware

Four large DC motors drive two pairs of mecanum wheels.

One small DC motor drives a lead screw.

Three electromagnets and three color sensors are mounted to the elevating platform.

Two motor driver shields (spec not yet known) will be used to drive all four wheel motors. An L298N may be used to drive the lead screw motor due to its low power requirement.

Two IR arrays will be mounted to the bottom of the robot. A distance sensor may be mounted on the front of the robot to help with picking up and placing blocks.

An arduino mega will serve as the brain of the robot and will communicate with the base computer using an xBee Radio.

Concept 1 - Autonomy

The robot will use a combination of line following and odometry. The robot will use the two IR arrays on its underside to localize itself and calibrate its odometry systems. Two IR arrays are used so that the robot can take advantage of its ability to strafe sideways.

Blocks will slide off the reloader onto the electromagnets on the elevating platform. The robot will strafe sideways to align one of its other electromagnets with the next falling block. Once the falling blocks are secured and their color is sensed, the robot will drive to the chassis to place the block in the next best location. Blocks can be placed on the side of the chassis by driving up to the side and releasing the magnet. Blocks can be placed on the top by elevating the platform, driving forward until the block is over the top location, and releasing the magnet.

We plan to use odometry to establish the location of the robot on the field in the form of a coordinate. Coordinates will be stored for locations of interest. Coordinates include the desired orientation of the robot at that coordinate. A simple path planning algorithm will be implemented to translate a pair of coordinates into a series of actions the robot will perform.

Concept 1 - Evaluation

Advantages

- Utilizes mecanum wheels: can place multiple blocks per reload, can use side strafing to place blocks
- Precise vertical positioning of blocks
- Only 1 DOF (plus electromagnets)

Disadvantages

- Can’t place blocks on side if blocks are already on side
- Electromagnets required to stay powered for most of runtime
- Lead screw may be tricky to get to work
- Front-heavy
- 3 Color sensors needed
- Precise vertical positioning of blocks

Metric Evaluation

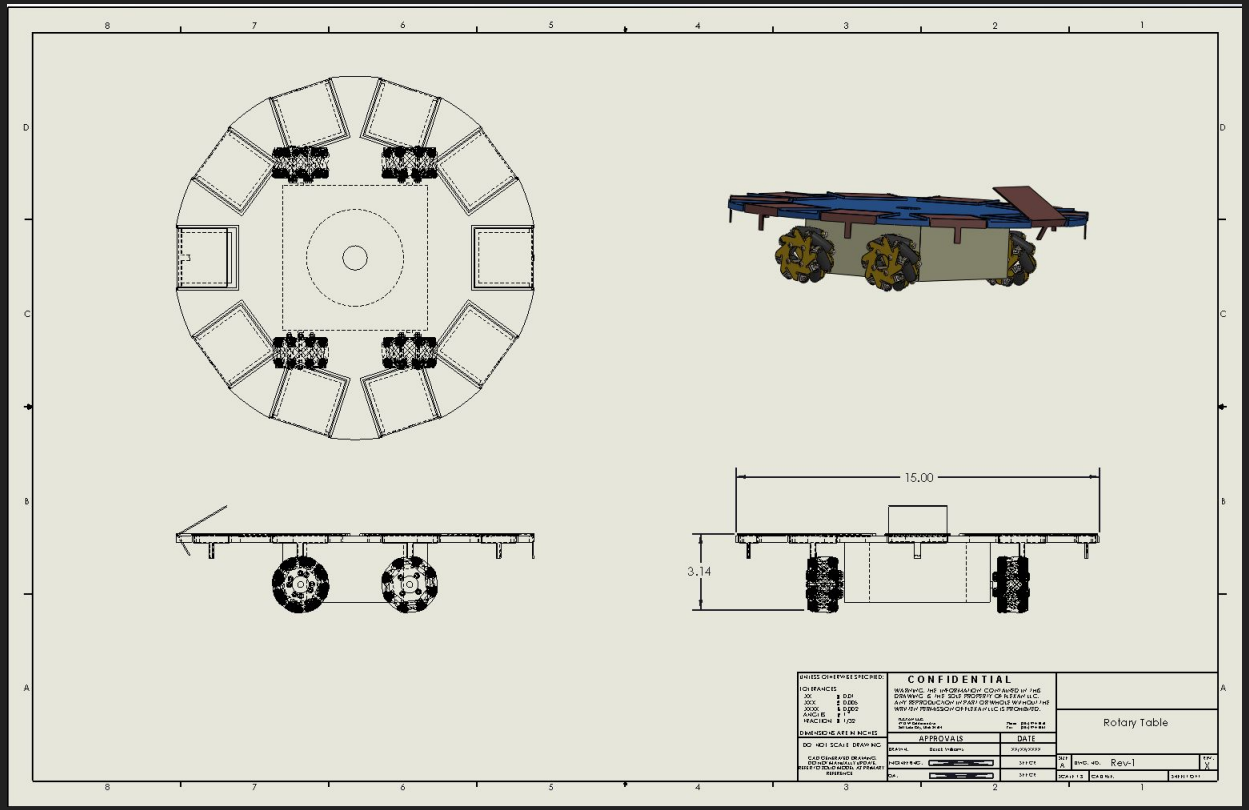
- Number of blocks per reload: 3
- DOF of block placing mechanism: 1
- Advantage gained from mecanum wheels (/10): 7
- Expected consistency of obtaining mechanism (/10): 8
- Expected consistency of placing mechanism (/10): 7

Concept 2 - “Rotary” Table

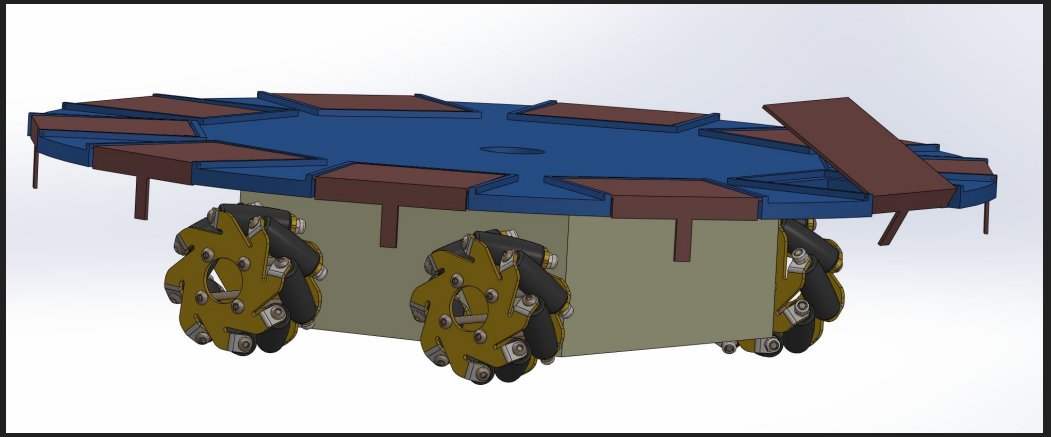
Codename: “Revolver”

Derek

Concept 2 - CAD



Concept 2 - Overview



- Entire robot rotates due to mecanum wheels then vectors for whichever slot is currently primary.

- Entire platform raises and lowers. Lower deck height is approximately 3” for receiving and off-loading side-chassis blocks. Upper deck height is approximately 6” plus deck thickness so flaps automatically off-load when robot approaches chassis at upper level height.
(upper deck height and lift mechanism not shown at this time)

Concept 2 - Hardware

- 4x mecanum wheels
- 4x wheel motors
- 2x motor drivers
- Ball screw/scissor lift style raising and lower mechanism
- 1x lift motor
- 1x lift motor driver
- 2x limit switches
- chassis, “rotary” table, 10x block flippers
- 10x color sensors
- 2x IR arrays for navigation assistance
- potential proximity sensors for recalibrations

Concept 2 - Autonomy

- Through the use of a predetermined grid/mapping system, IR arrays, and proximity sensors, the robot will navigate to locations and recalibrate on the fly for precision pickup and drop-off of blocks.

- Off-loading of blocks will occur naturally on the sides of the chassis and automatically/manually on the top of the chassis through the use of flipper platforms.

Concept 2 - Evaluation

Advantages

- Holds lots of blocks
- Limit switches for digital platform height
- Utilizes mecanum wheels to rotate whole mechanism
- Lever flaps allow for a simple mechanical solution for placement

Disadvantages:

- Too big as drawn
- Too many color sensors
- Range finding for every spot
- Similar problem with blocks already in slots as concept 1

Metric Evaluation

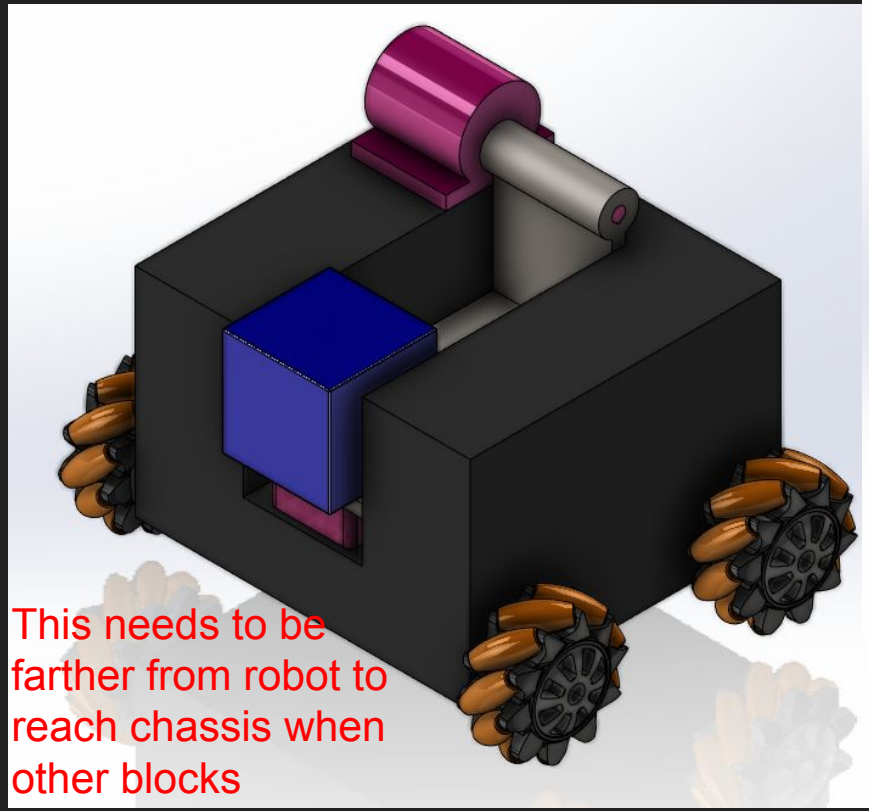
- Number of blocks per reload: 10 (as drawn)
- DOF of block placing mechanism: 2
- Advantage gained from mecanum wheels (/10): 10
- Expected consistency of obtaining mechanism (/10): 5
- Expected consistency of placing mechanism (/10): 4

Concept 3 - 1 Block Arm

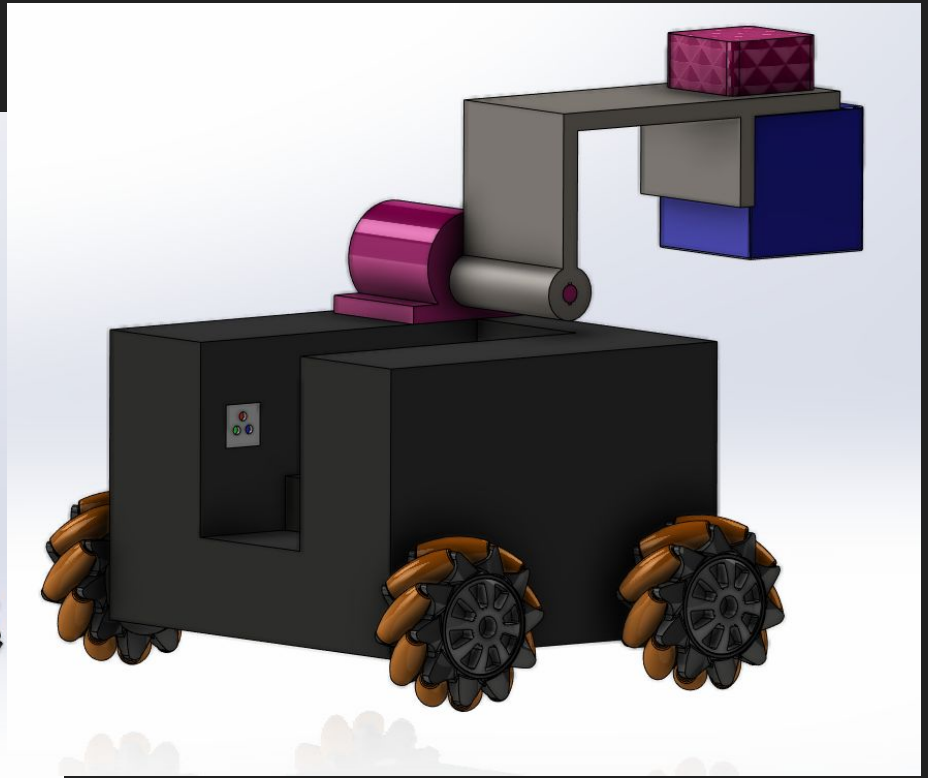
Codename: “Skywalker”

Andrew

Concept 3 - CAD



This needs to be farther from robot to reach chassis when other blocks



Concept 3 - Overview

- 2 DOF’s
  - Motor to turn arm
  - Electromagnet (or other device if preferred) to grip block
- 2-placement positions
  - Bottom level catches blocks, and can place blocks. Color sensed here.
  - Upper level for placement on top of chassis–uses gripper
- Gameplan
  - Fast - Small and lightweight, moves quick with Mecanum wheels
  - Simple - 2 desired arm positions, binary gripper.

Concept 3 - Hardware

- x5 DC motors : x4 for Mecanum wheels, x1 for Arm
- x1 Electromagnet : For gripper
- x1 Color Sensor
- x2 IR Arrays : Localization
- x4 Ultrasonic Sensors : x2 for each side of robot chassis
- x2 Motor Shields : Drivers & Encoders for Mecanum Wheels
- x1 Arduino Mega

Concept 3 - Autonomy

Localization: Use IR sensors to calibrate current position and orientation on line T-junction on map. Use Ultrasonic Sensors to calibrate orientation against Chassis.

1) Collect block
    a) Navigate to reloader
    b) Align with reloader, press button, catch block with arm in lower position

2) Place block
    a) Read block color
    b) Drive to Chassis
    c) IF red/blue, place on bottom of Chassis
        i) Turn 180 deg
        ii) Run into chassis
    d) ELSE place on top of Chassis
        i) Start gripper
        ii) Rotate arm to top position
        iii) Release gripper

3) Repeat

Concept 3 - Evaluation

Advantages

- Fast placement on top and bottom levels
- Small and light (6” x 6” currently)
- Binary gripper (can be off most of the time)
- Simple

Disadvantages

- 1 block at once
- Can’t utilize strafing ability of mecanum wheels

Metric Evaluation

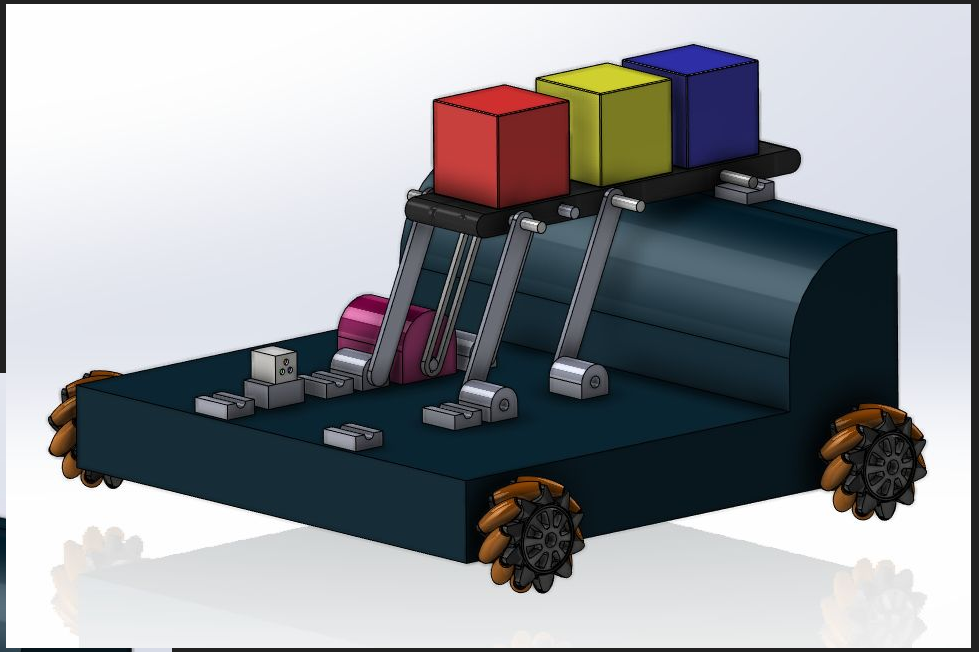
- Number of blocks per reload: 1
- DOF of block placing mechanism: 2
- Advantage gained from mecanum wheels (/10): 6
- Expected consistency of obtaining mechanism (/10): 10
- Expected consistency of placing mechanism (/10): 10

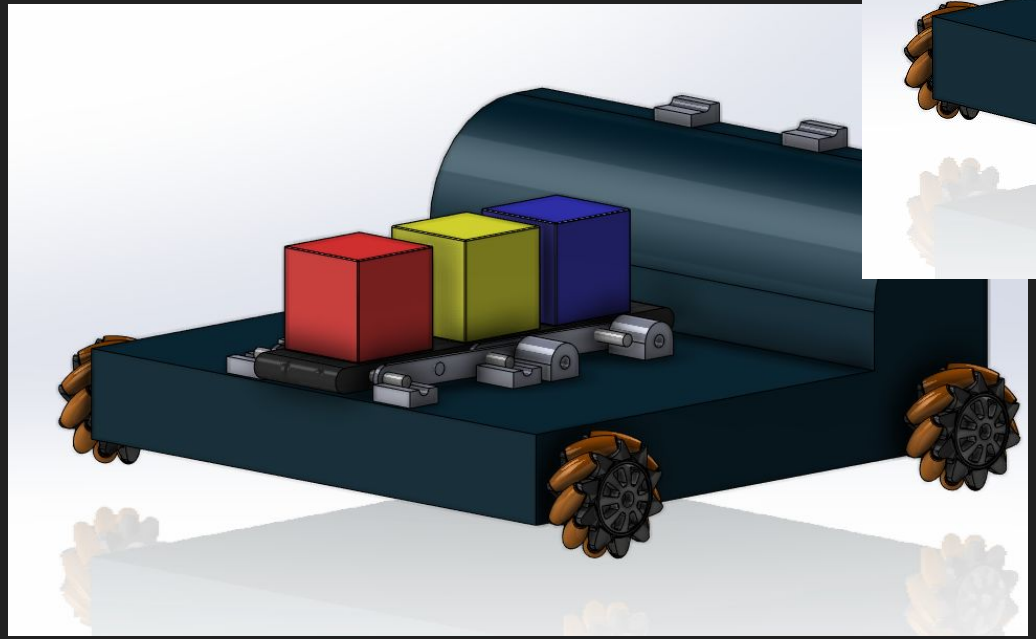
BONUS CONCEPT: Moveable Conveyor Belt

Codename: “Convoy”

Andrew

Bonus Concept - CAD





Bonus Concept - Overview

- *2 DOF's*
  - *Motor to raise conveyor*
  - *Motor to turn conveyor*
- *2-placement positions*
  - *Bottom level catches blocks, and can place blocks. Color sensed here.*
  - *Upper level for placement on top of chassis–uses gripper*
- *Gameplan*
  - *Collect multiple (4) blocks at reloader*
  - *Figure out placement positions*
  - *Place while strafing with Mecanum Wheels*

Bonus Concept - Hardware

- x6 DC motors : x4 for Mecanum wheels, x1 for Arm, 1x for Conveyor

- x1 Color Sensor
- x2 IR Arrays : Localization
- x4 Ultrasonic Sensors : x2 for each side of robot chassis
- x2-3 Motor Shields : Drivers & Encoders for Motors
- x1 Arduino Mega

Bonus Concept - Autonomy

Localization: Use IR sensors to calibrate current position and orientation on line T-junction on map. Use Ultrasonic Sensors to calibrate orientation against Chassis.

1) Collect block
    a) Navigate to reloader
    b) Align with reloader, press button, catch block with conveyor in bottom position

2) Place block
    a) Read block color
    b) Drive to Chassis
    c) IF red/blue, place on bottom of Chassis
        i) Turn 180 deg
        ii) Place block at front of conveyor
        iii) Run into chassis
    d) ELSE place on top of Chassis
        i) Raise conveyor
        ii) Run conveyor until 1 block falls

3) Repeat

Bonus Concept - Evaluation

Advantages

- Multiple block storage and placement
- Takes big advantage of strafing
- Binary block height
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Disadvantages

- Dequeue Storage (only 2 block options)
- Raising belt may be slow
- Top blocks may be difficult to place if a block is already on the side.

Metric Evaluation

- Number of blocks per reload: 4
- DOF of block placing mechanism: 2
- Advantage gained from mecanum wheels (/10): 9
- Expected consistency of obtaining mechanism (/10): 8
- Expected consistency of placing mechanism (/10): 8

Decision Matrix

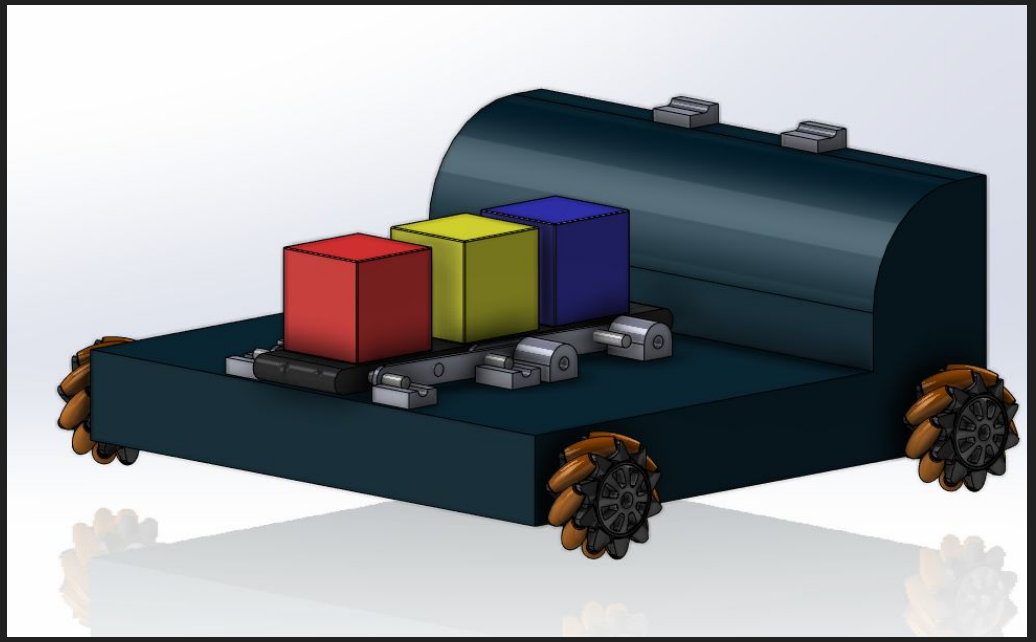
	# of blocks per reload	DOF of block placing mechanism	Advantage gained from mecanum wheels	Consistency of receiving blocks	Consistency of placing blocks
Triclops	3	1	7	8	7
Revolver	10	2	10	5	4
Skywalker	1	2	6	10	10
Convoy	4	2	9	9	9

Decision

The decision is:

Wait for it……..

Convoy (with rotating design switched for a scissor jack)



Highest composite score. Most interesting to us.