Capstone Design I

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박태룡, 현규진, Abi, and Fahim

Professor: 한순흥 / TA: 한경석

Organization Chart

Prof. 한순흥

TA: 한경석

Solid Works | Lab View | Open CV | ROS

권영석
Leader

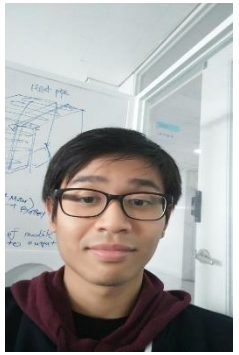
김동현

김원빈

박태룡

김현준

Fahim Masum

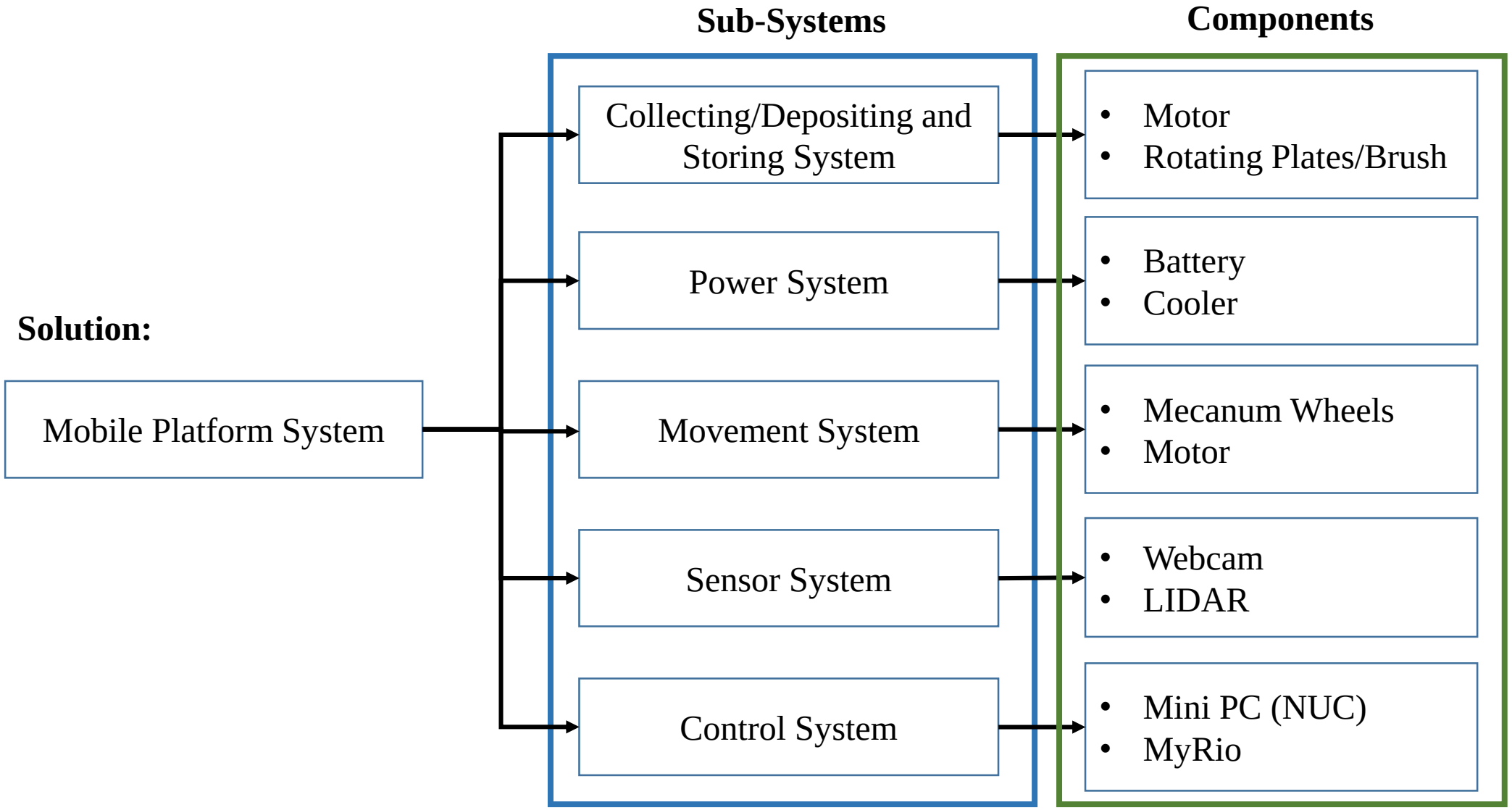


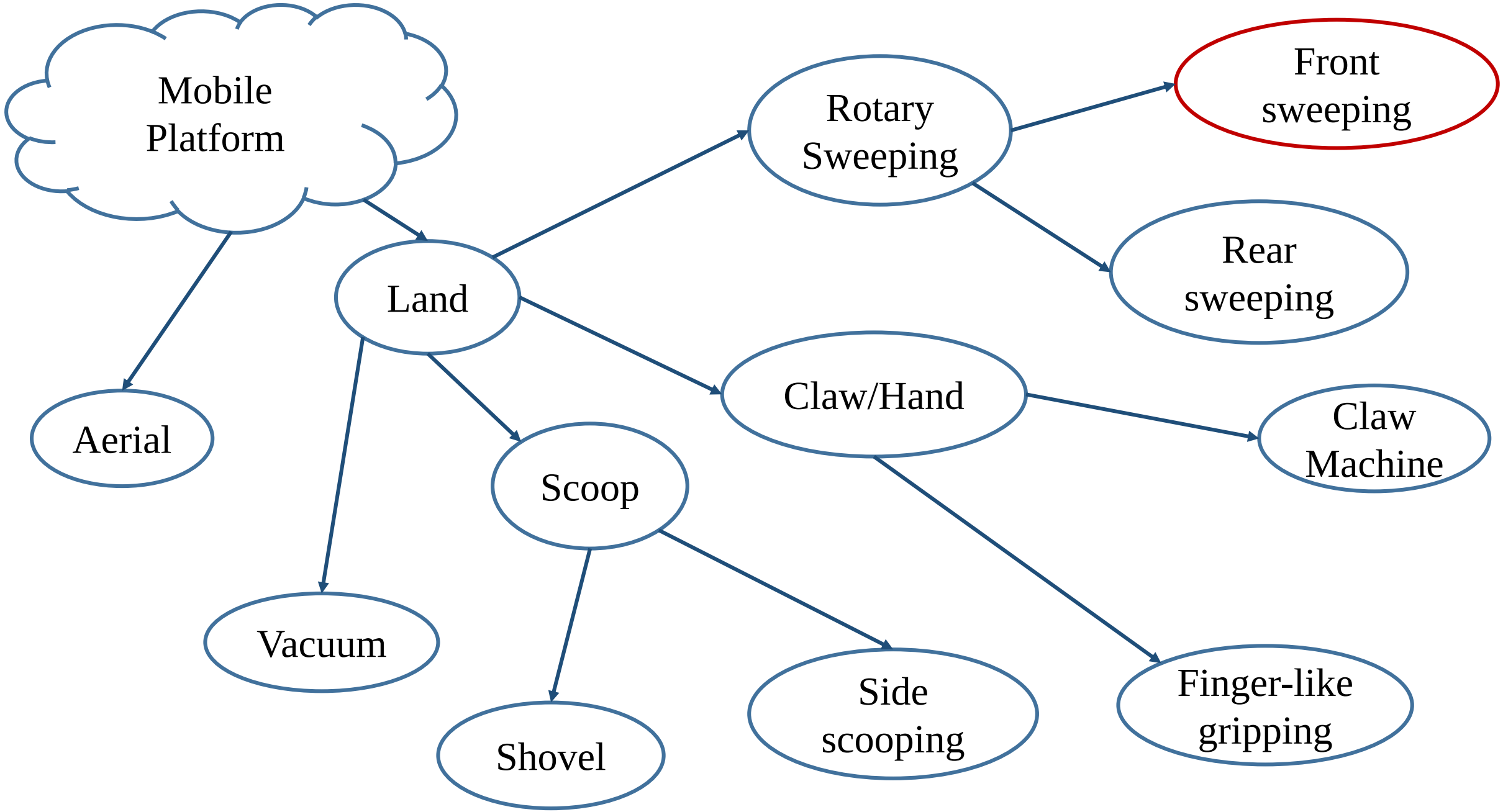
Abi Rahman Syamil

현규진

Design Goal : Find and collect the specific balls and transport them to the goal efficiently.

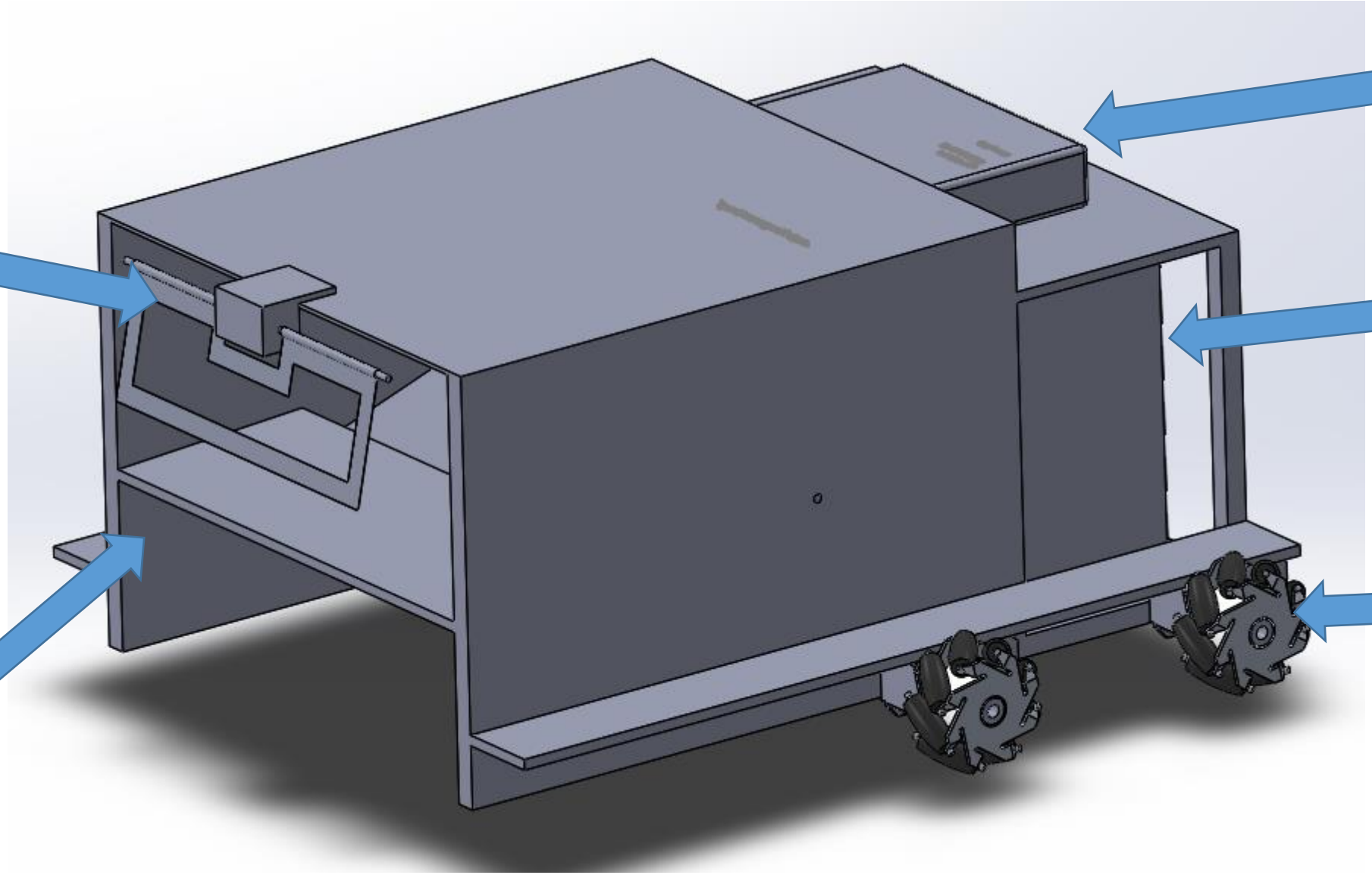
Solution:




Mobile Platform
Aerial
Land
Vacuum
Scoop
Shovel
Rotary Sweeping
Front sweeping
Rear sweeping
Claw/Hand
Claw Machine
Side scooping
Finger-like gripping

Overall View of Our Product!

<Alternative 1>

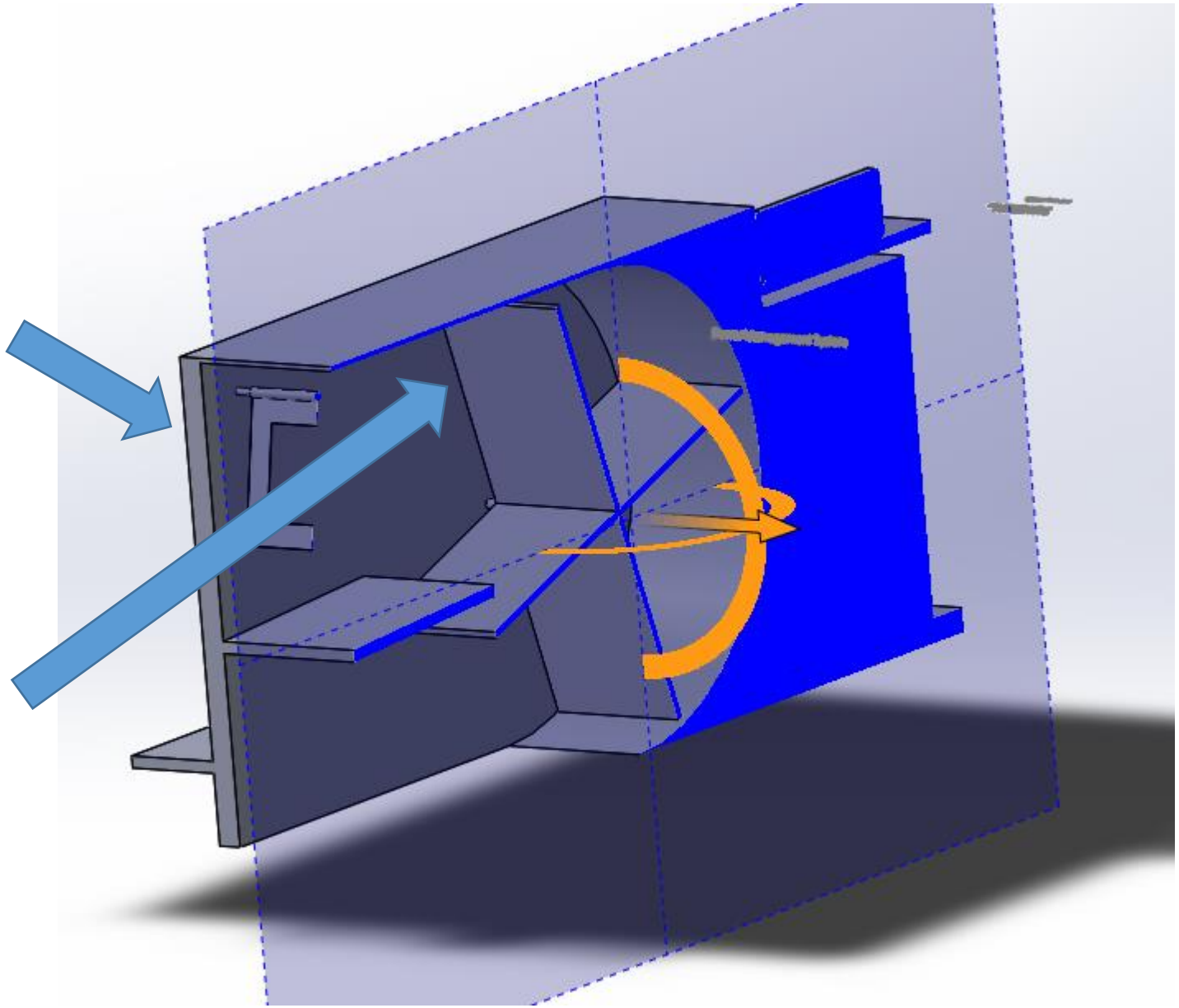


Overall View of Our Product!

<Alternative 1>

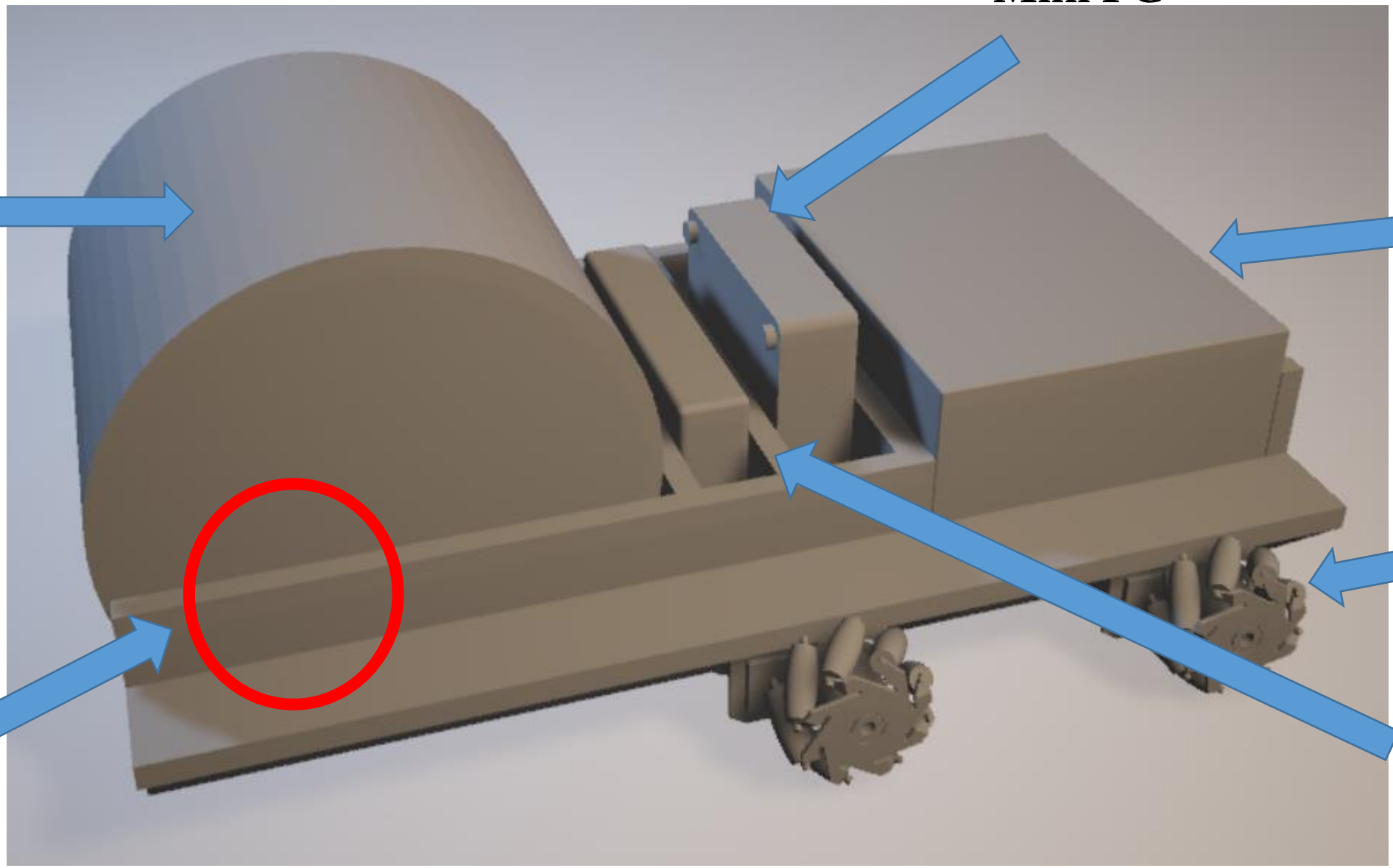
Step Motor

Picking part

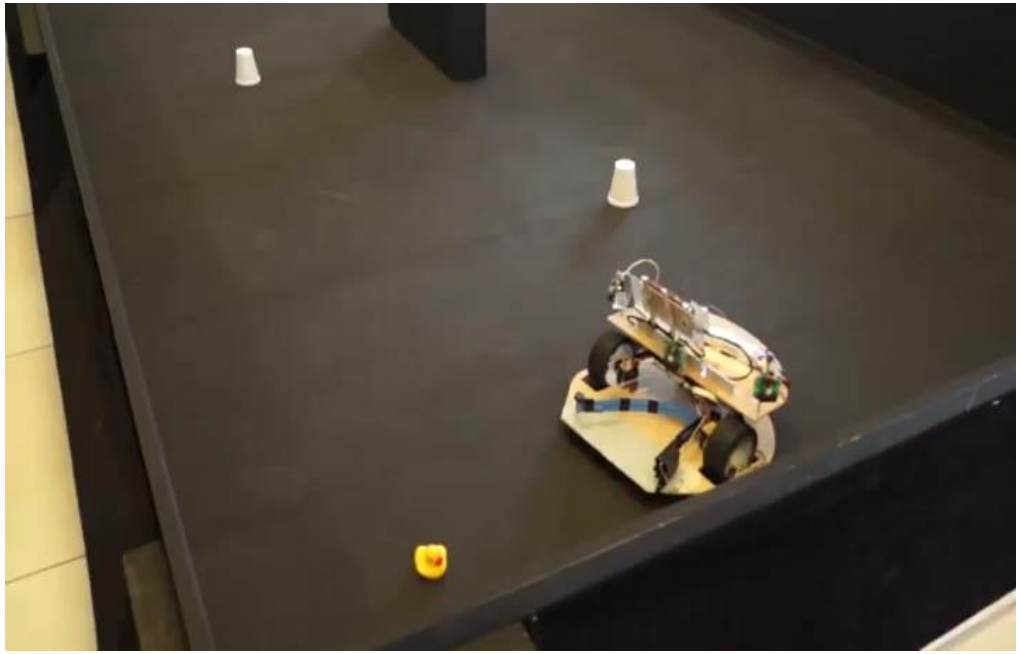


Overall View of Our Product!

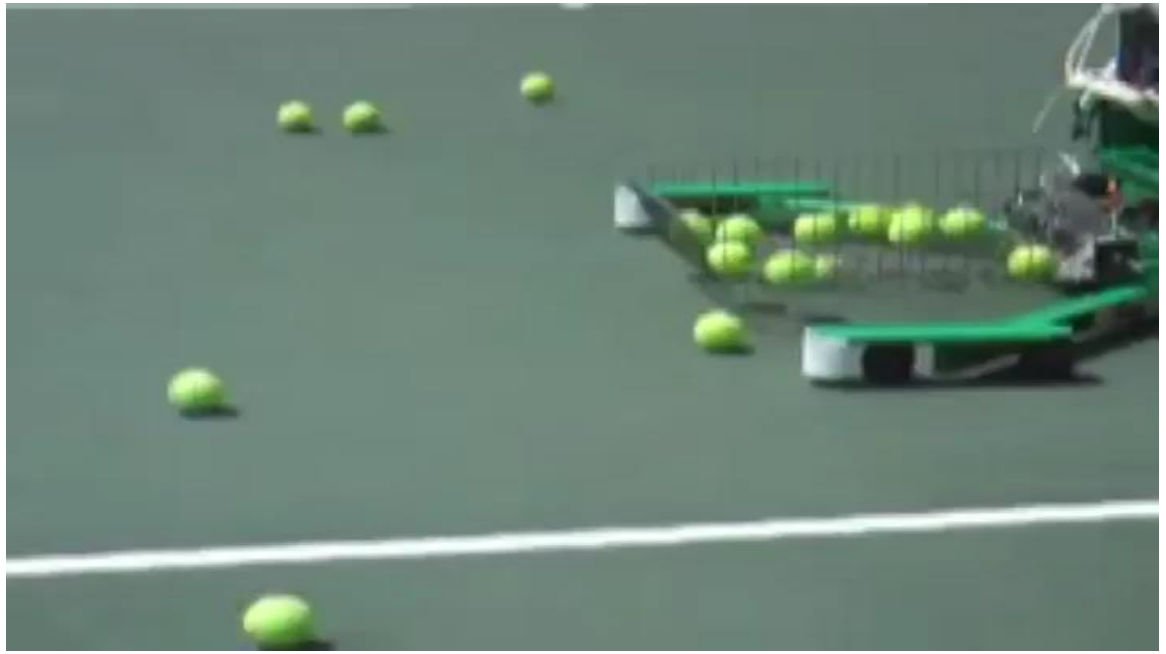
<Alternative 2>



Pick up Method

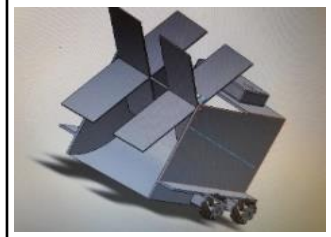
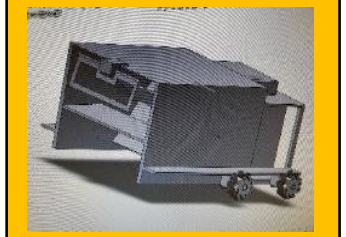
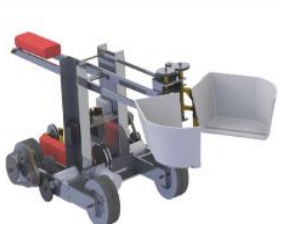
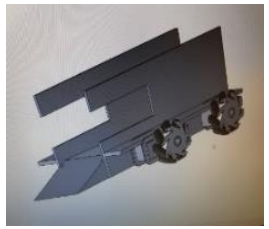


https://m.youtube.com/watch?v=Fx5uhWKudRw

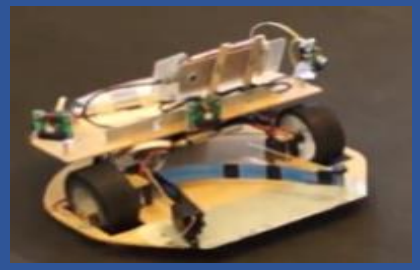


https://m.youtube.com/watch?feature=youtu.be&v=glmBBZzWq40

Decision Matrix for Collecting Systems

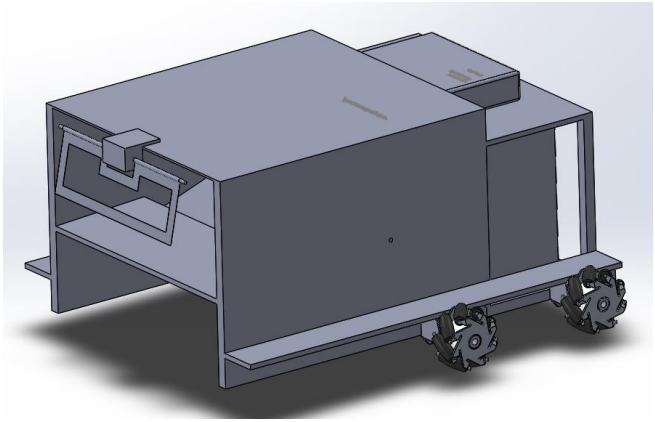
Best method for collecting and depositing		Front-Sweeping 	Back-Sweeping 	Claw-Scoop 	Scoop 	Sweep-and-Store 	Snatch-Band 
Weight	10	0.54	0.54	0.52	0.58	0.54	0.65
Creativity	5	0.40	0.56	0.35	0.40	0.65	0.70
Heating	30	0.58	0.58	0.50	0.65	0.58	0.58
Vibration	20	0.46	0.46	0.50	0.65	0.50	0.50
Speed	35	0.45	0.60	0.58	0.40	0.63	0.58
Satisfaction		49.75	55.80	52.25	54.30	58.10	57.70

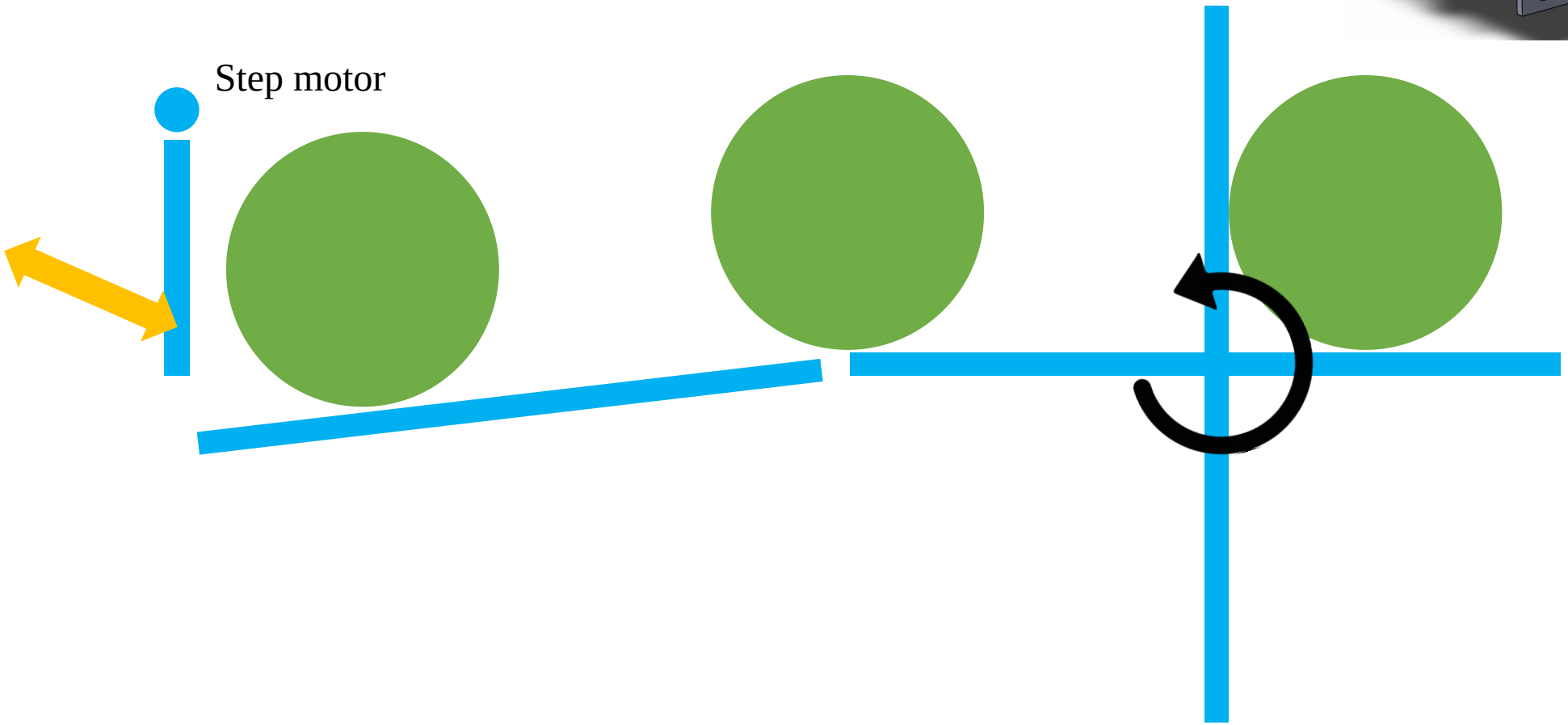
Pro-Con for Collecting Systems

	Pro	Con
	Fast pick-up. Easy Camera and Lidar placement.	Unsure depositing method. Component configuration relatively harder.
	. Simple mechanically. Relatively fast (less motors). Main components easy to build. Pretty unique.	Camera and Lidar placement is challenging. Small margin of error in pick-up.
	Very unique. Mechanically simply structure and pick-up.	Unsure material selection. Storing is difficult. No ideas about depositing.

Pick Up Method

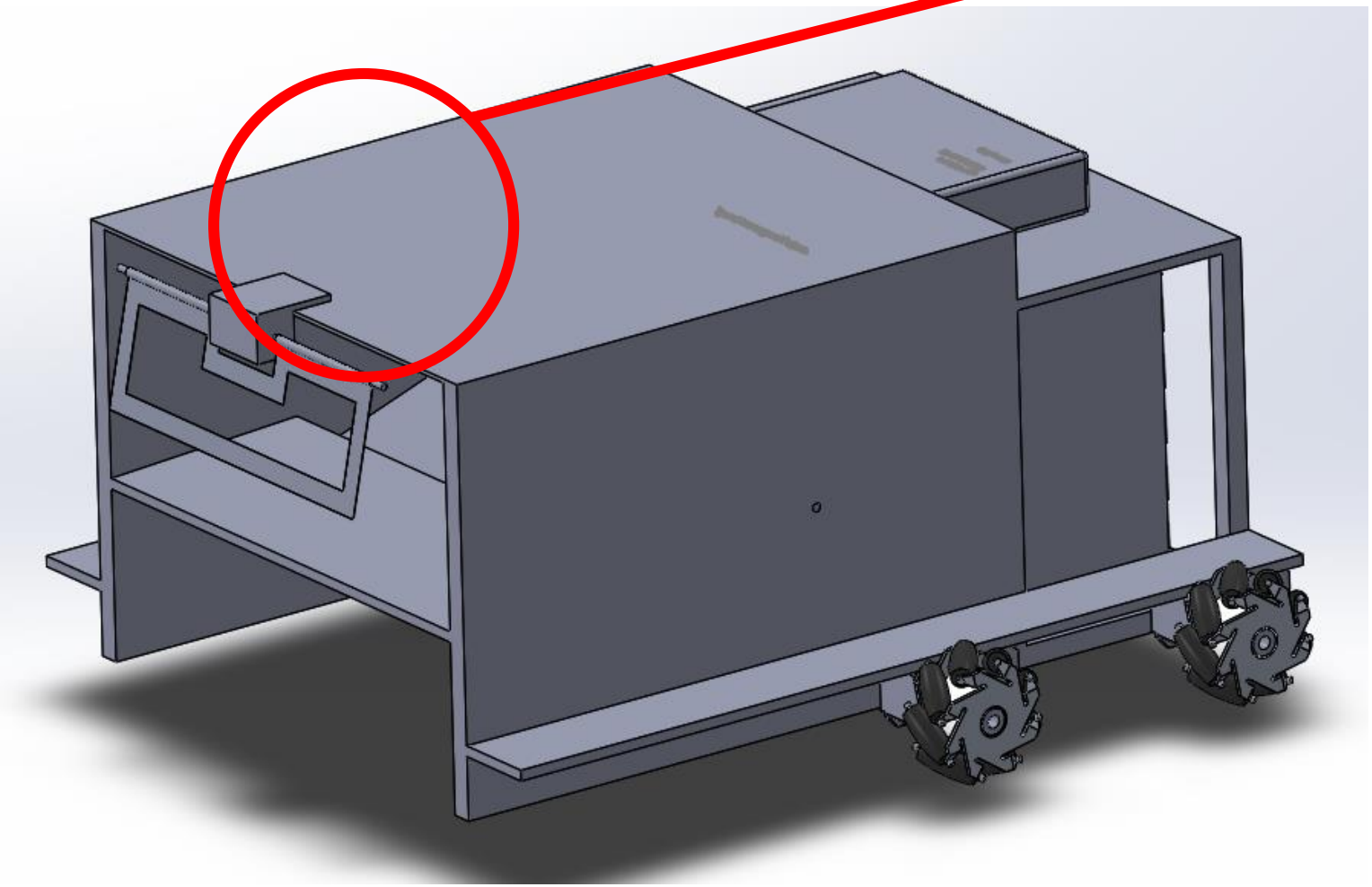
- Alternative 1





Pick Up Method

- Alternative 1

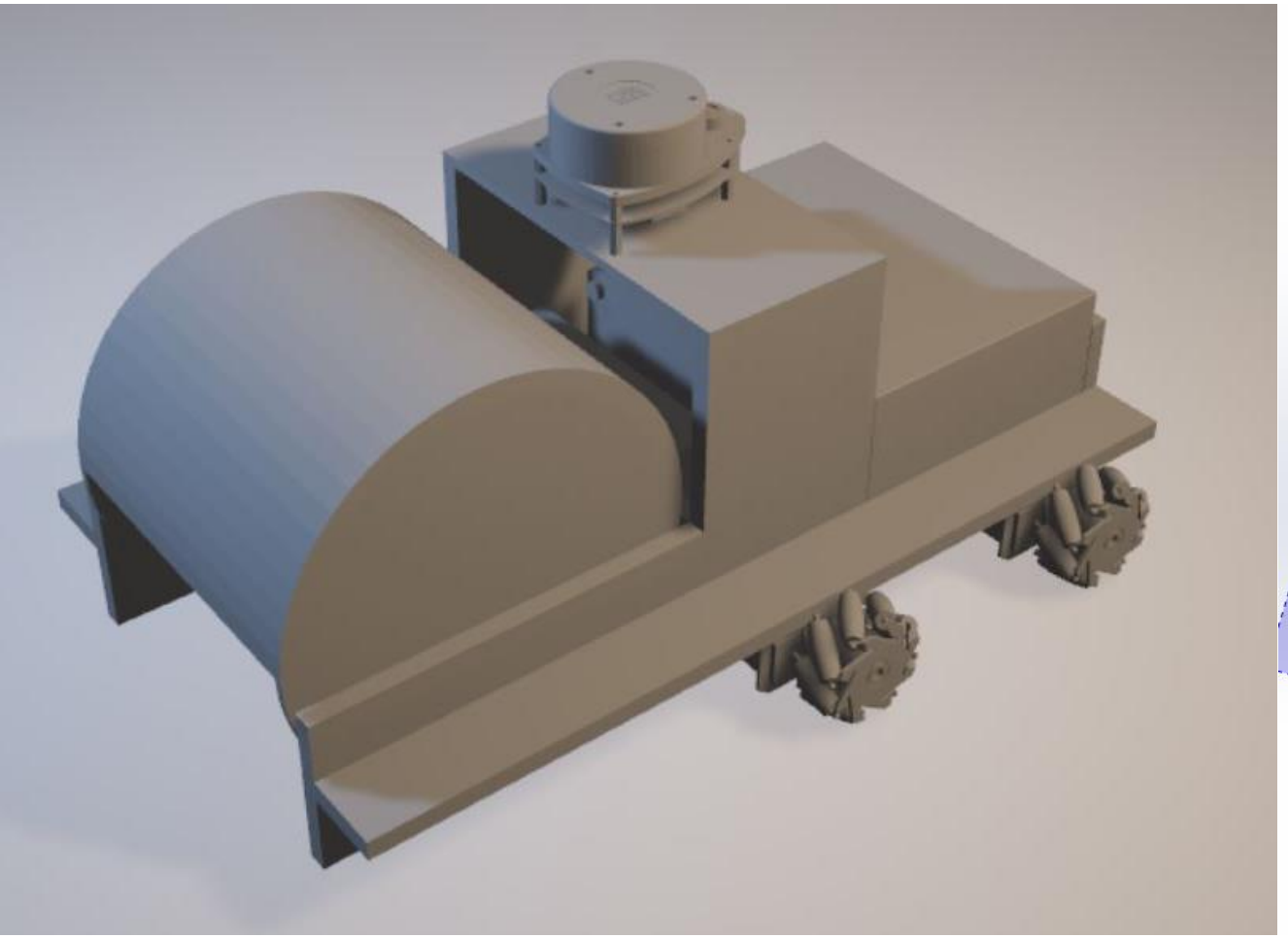


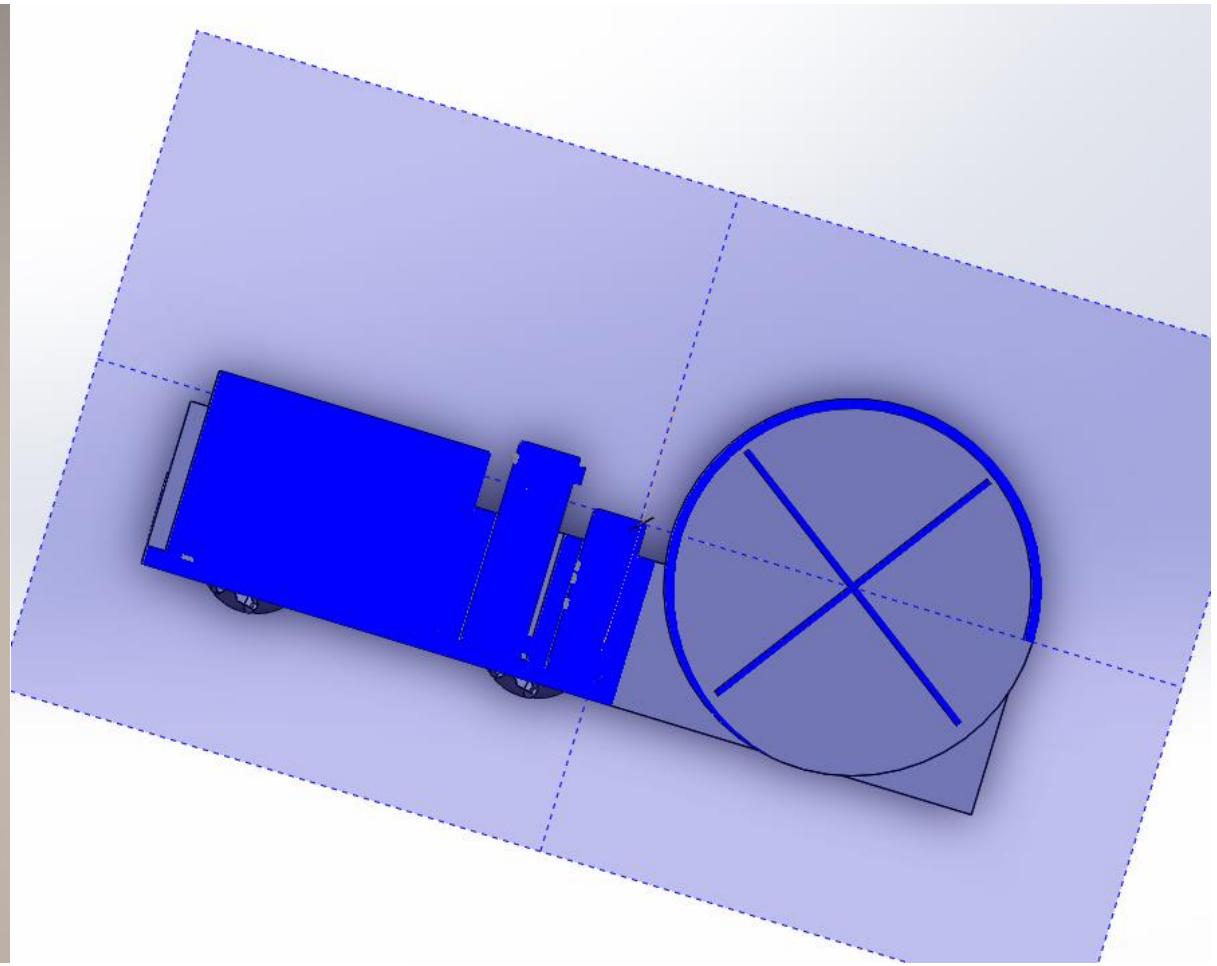
Possible Problems

- Bulky and high
- PMS and MyRio might be hot

Pick Up Method

- Alternative 2: Our Leading Concept!



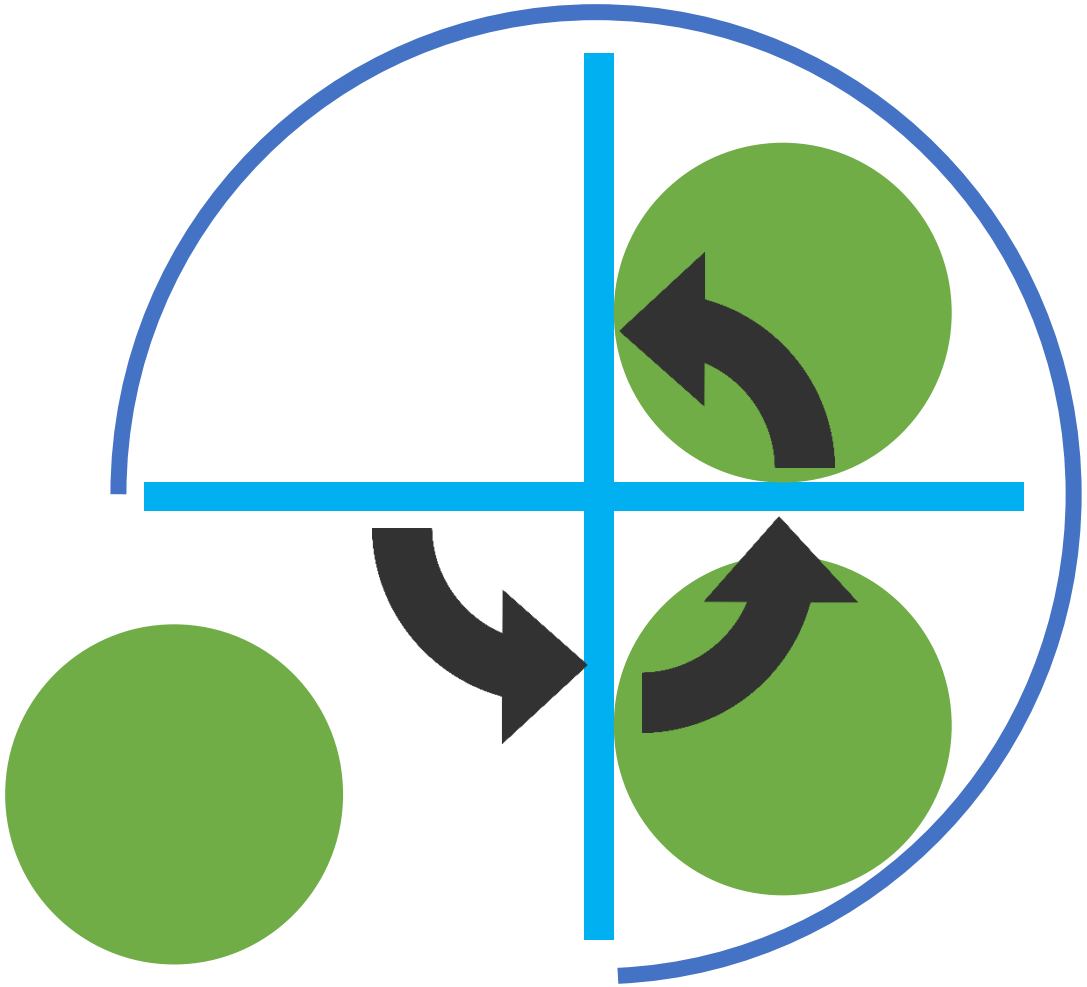


Pick Up Method

- Concept 2

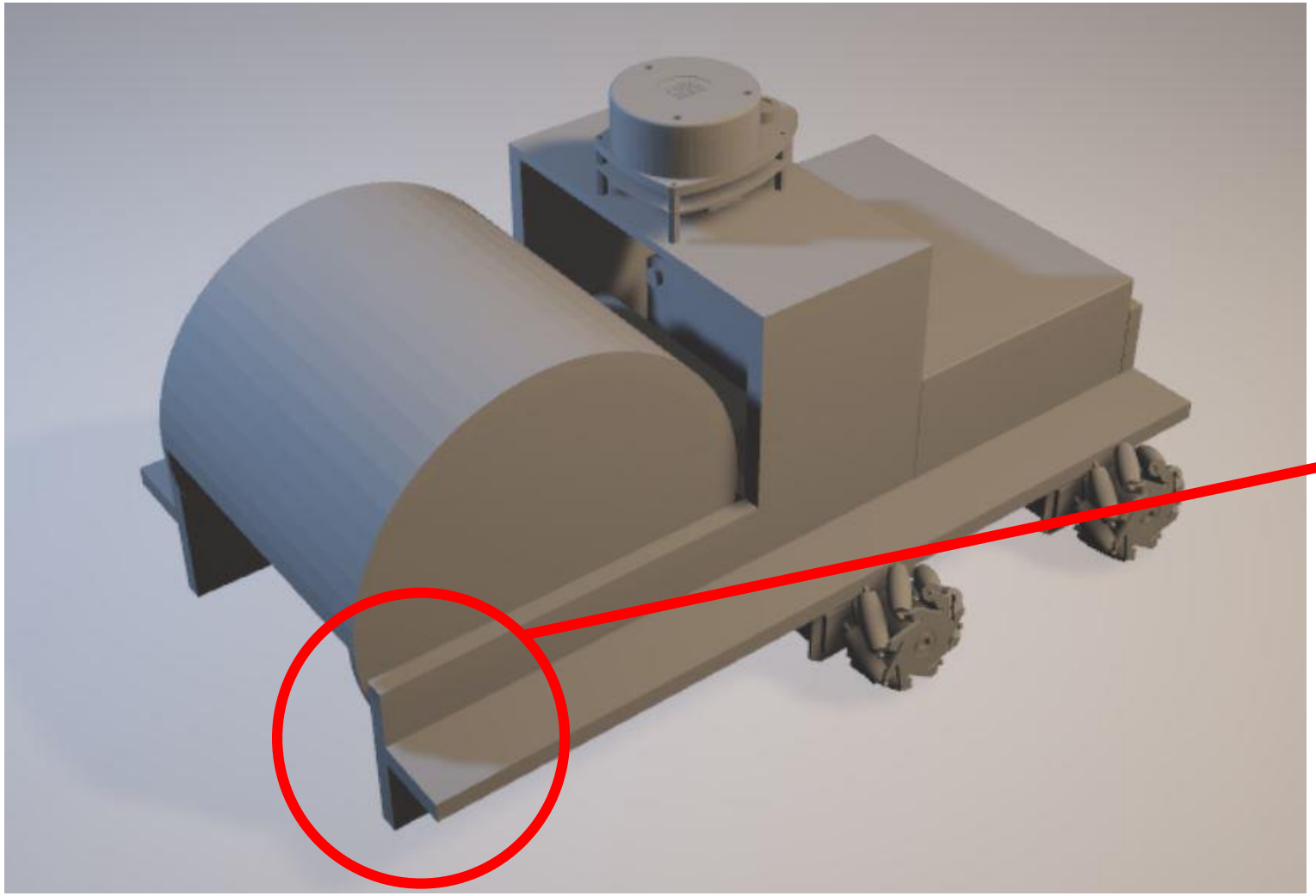
Only one motor need to collect and dispose the balls

Collecting & Storing & Disposal methods integrated



Pick Up Method

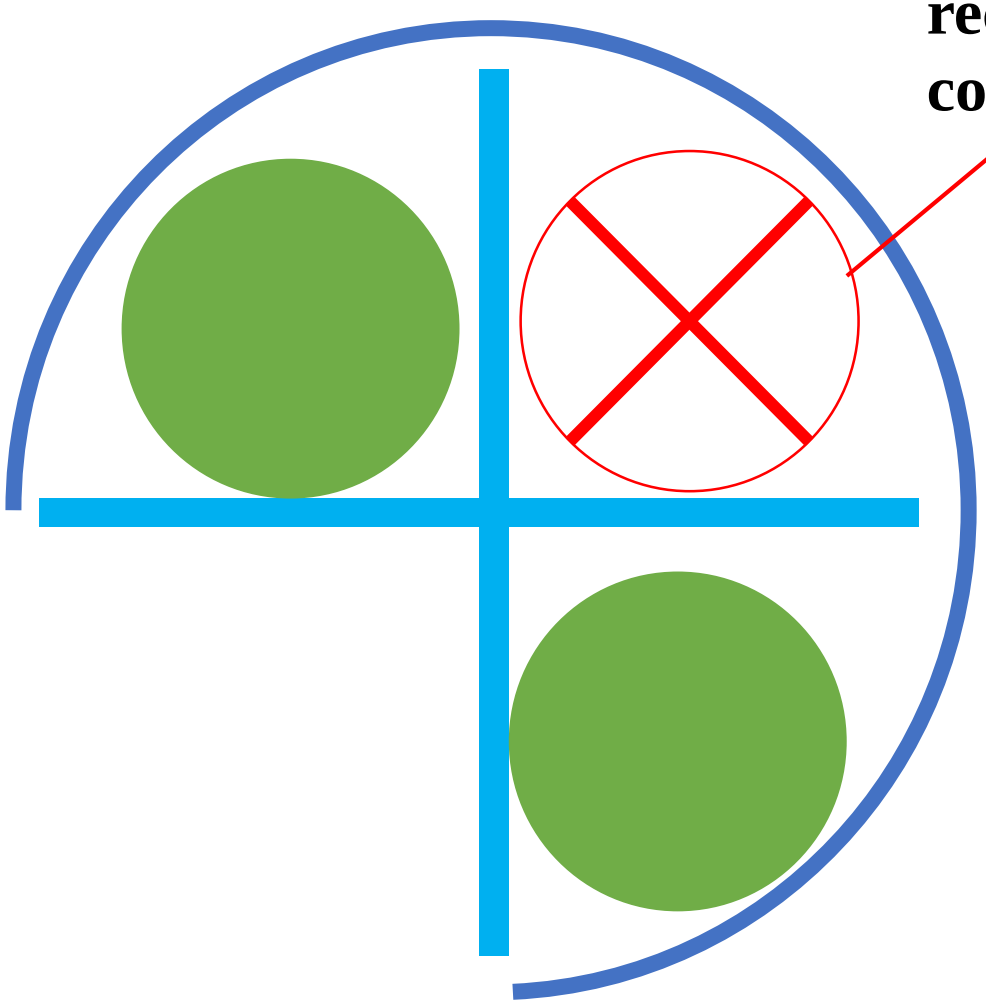
- Alternative 2



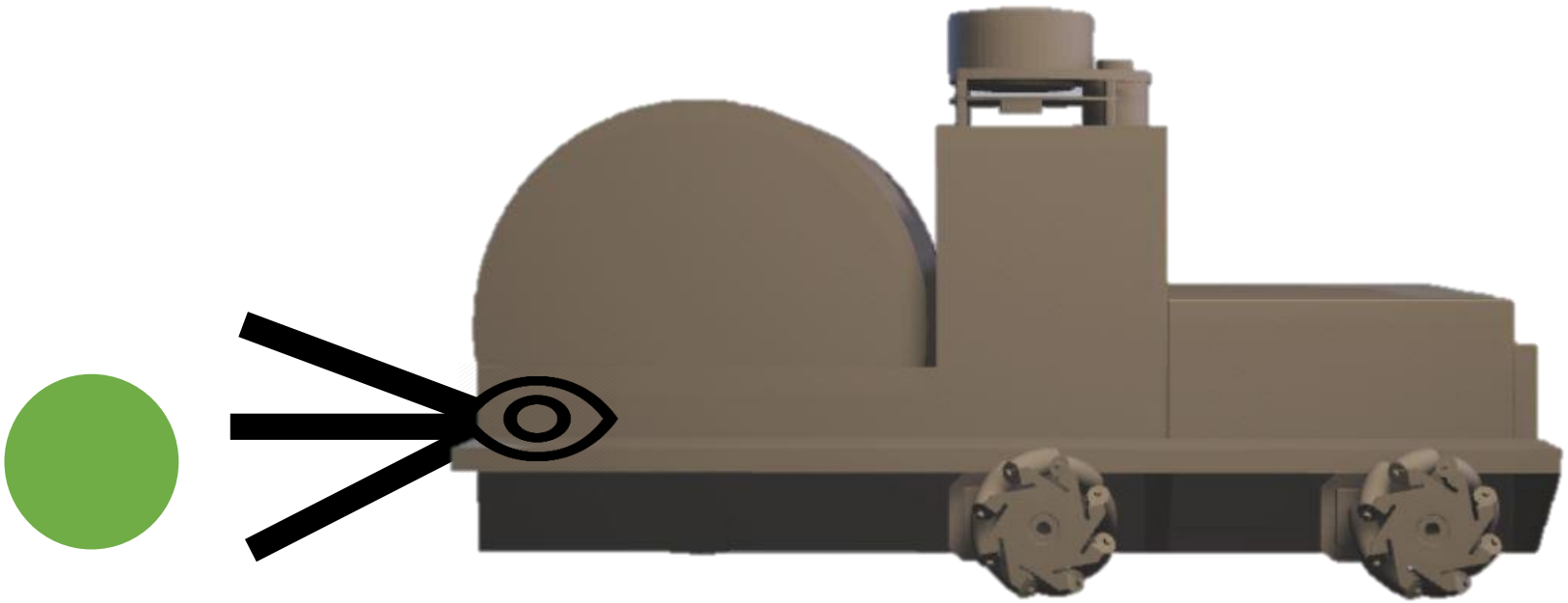
Camera will be mounted here

Possible problem 1

The case when mobile platform recognized 3 balls but it is failed to collect the second ball



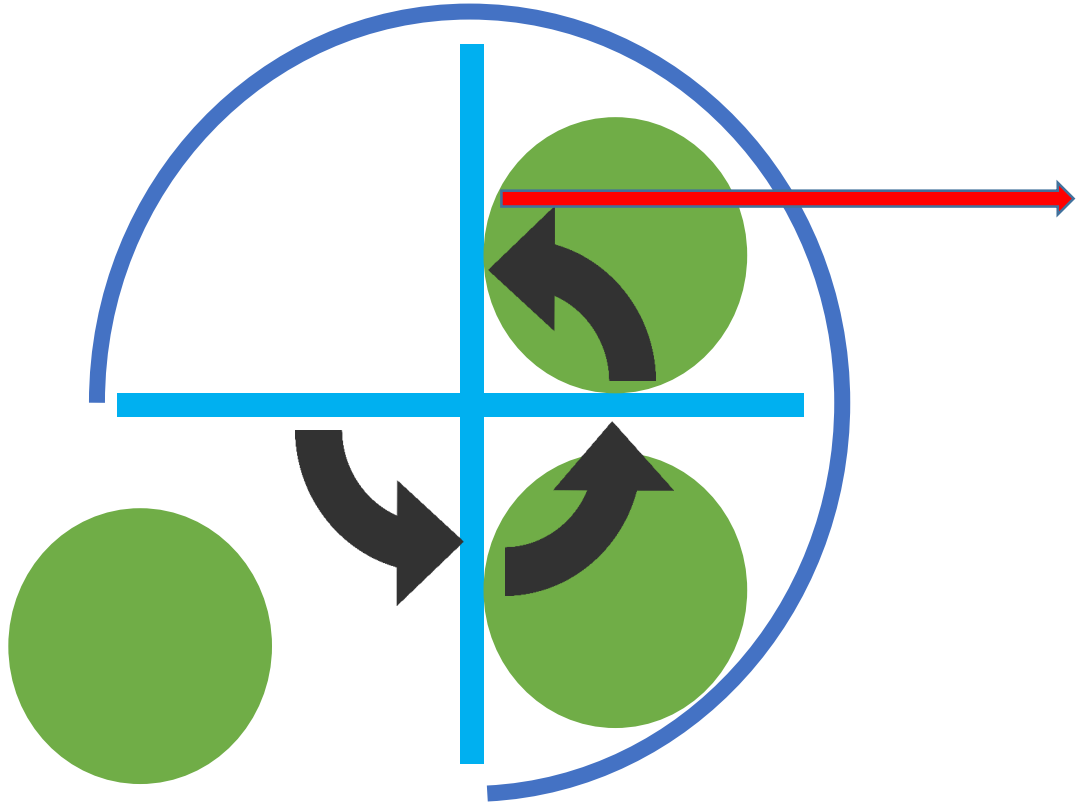
Solution 1

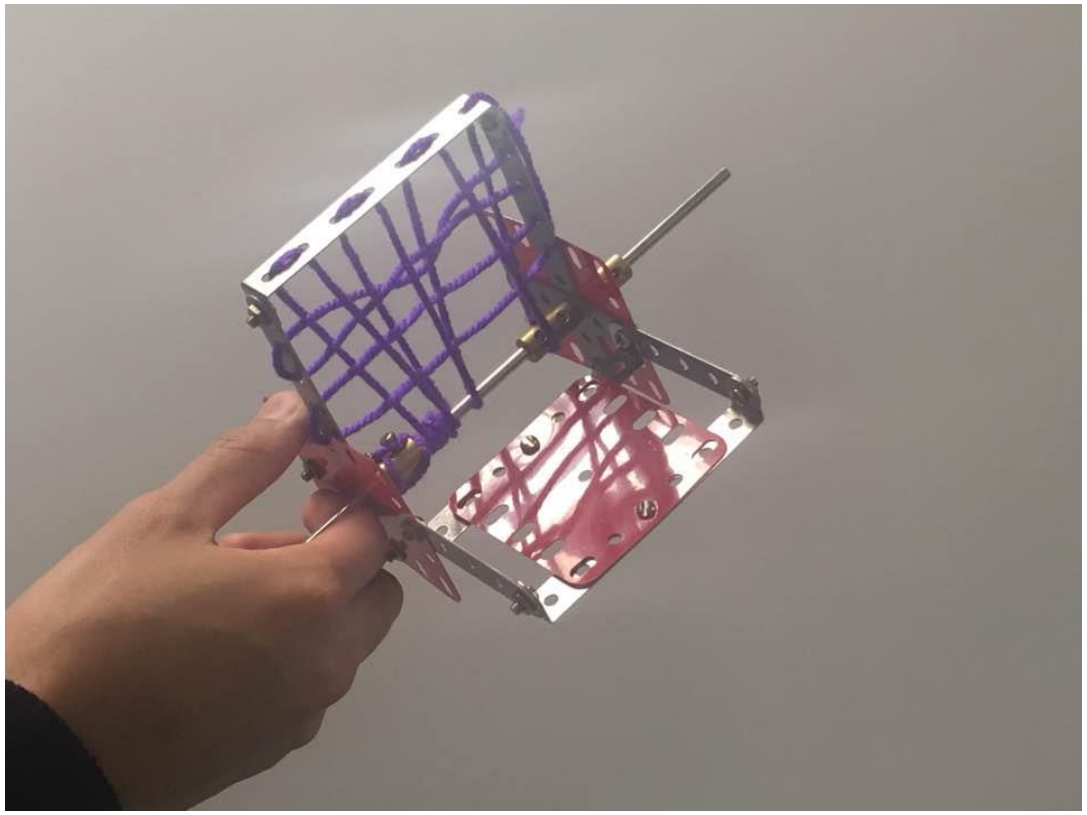


Once the robot pick a ball, then Go back little And Double check !!

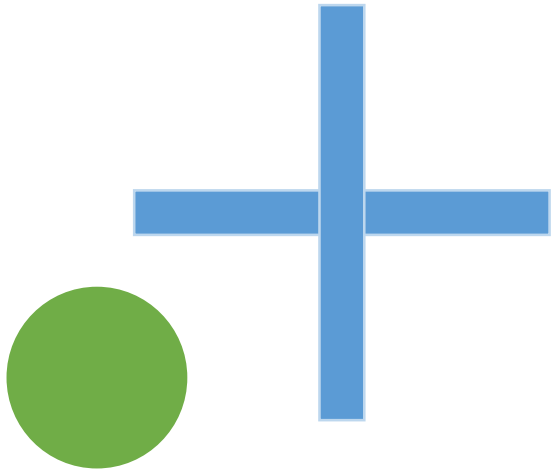
Solution 2

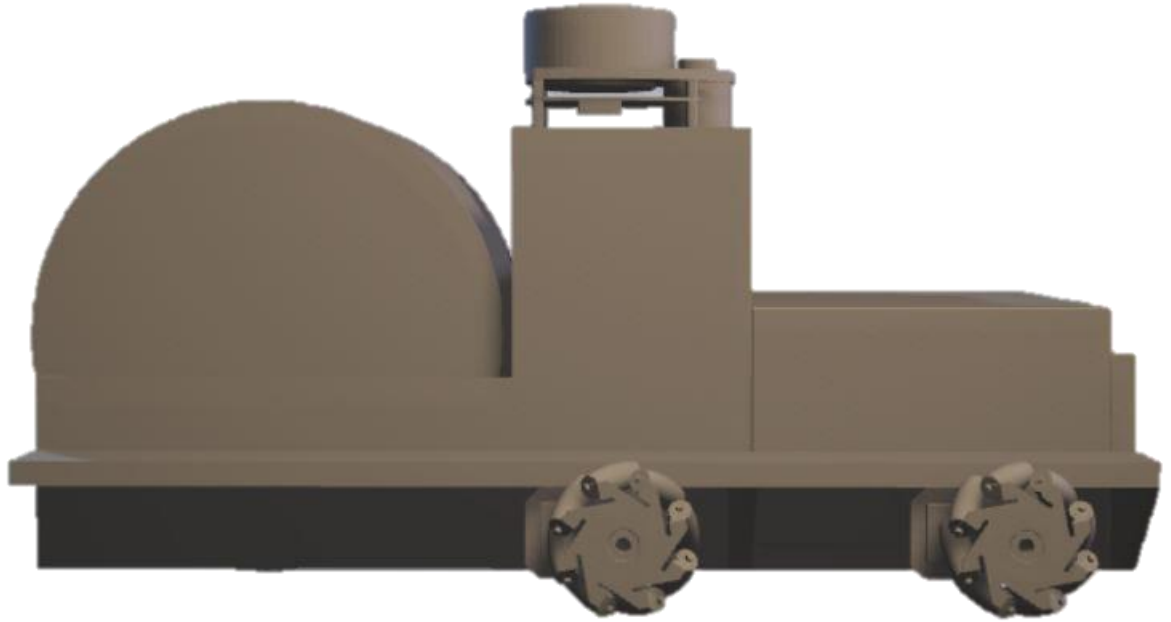
Design picker to grab the ball easily





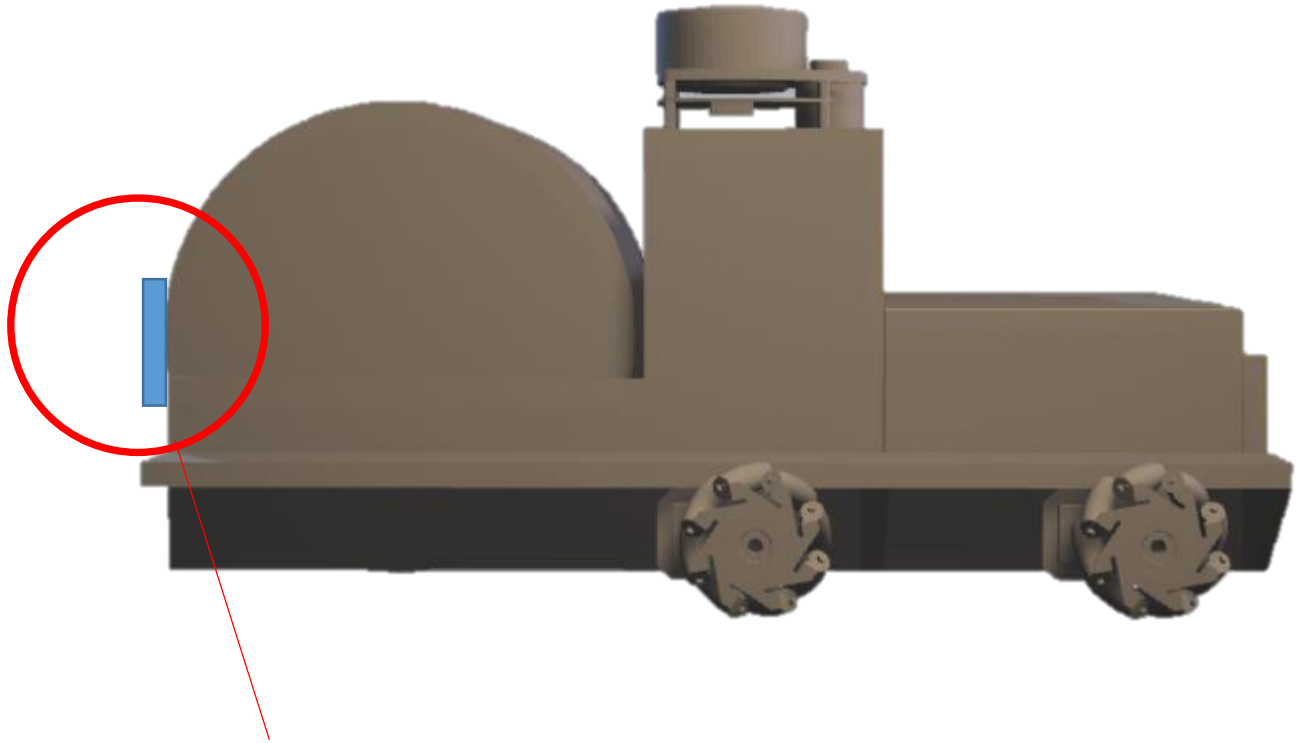
Possible problem 2





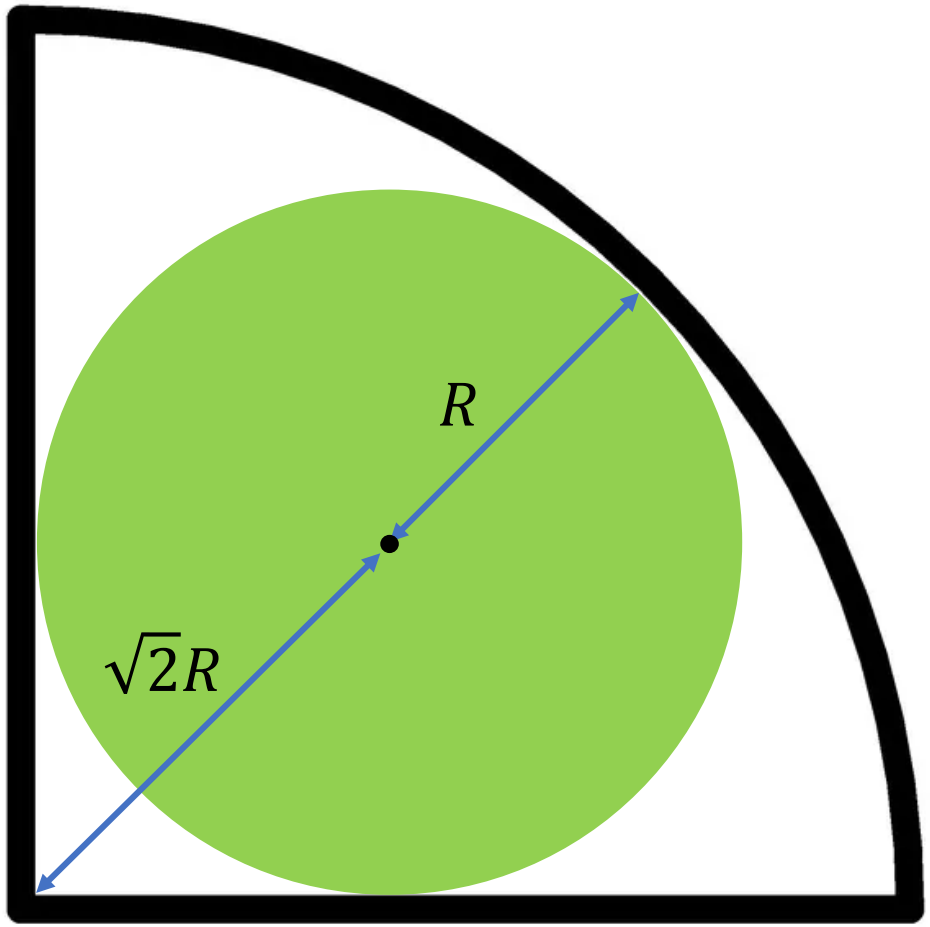
Ball can escape away from vision range

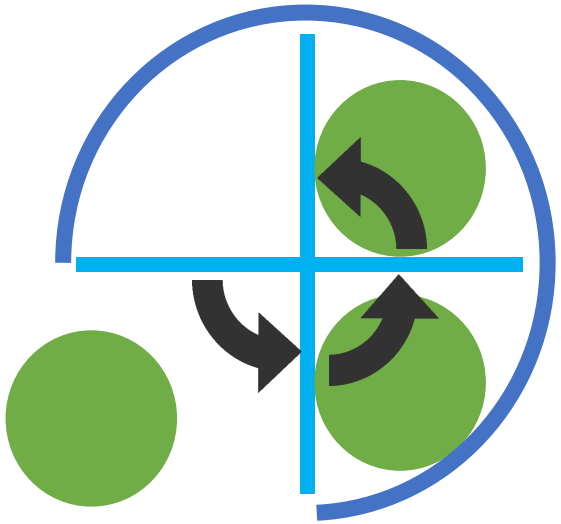
Solution 2



Attach a sensor such as laser which can check mobile platform collect the ball

Analysis – Collector size





$$(1+\sqrt{2})R \leq R_{collector}$$

$$R \approx 4(cm)$$

$$10(cm) \leq R_{collector}$$

Cooling mechanism

Cooling mechanism

1.Water&Oil cooling

- There must be no leaking or Condensation
  → We should consider sealing
- Weight of fluid → require extra power → inefficient!
  (water cooling also need pump!!)

Cooling mechanism

→By water cooling, We may absorb heat from only partial surface of battery

→ By oil cooling, we can make battery to sink into the oil, but, we have to deal with Capillary phenomenon in the wire.

Cooling mechanism

2. Convection by using fin&fan

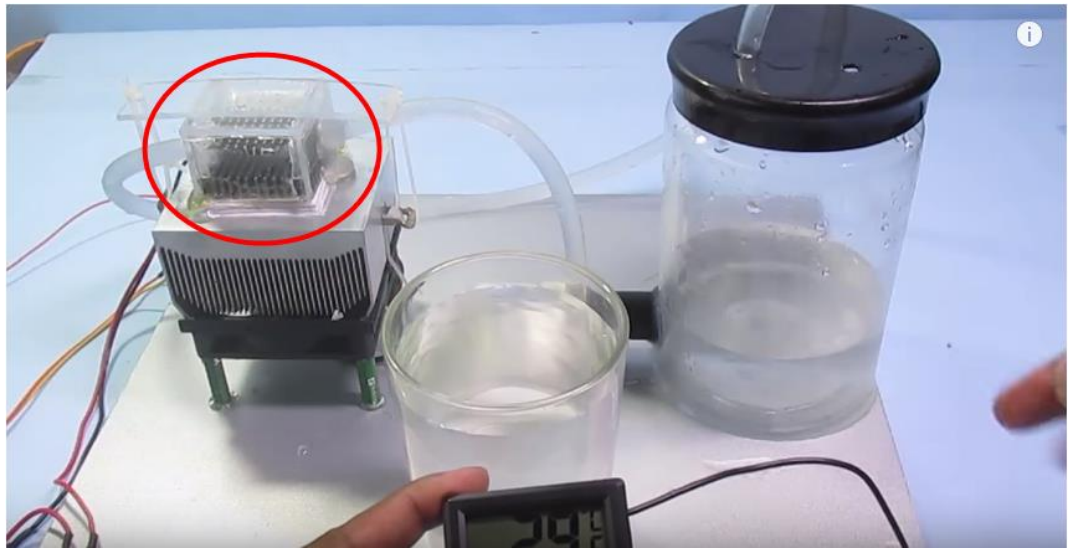
- Maximize Convection surface by using fin

3. Peltier

- It will consume quite much power.
- We need to install extra heat sink → weight&volume increase

Cooling mechanism

→ we may use both ice pack & fan



→ We need mediation source for heat exchange between peltier and battery
(combine water cooling & peltier)

Pro-Con Analysis for Cooling System

	Pros	Cons
Air cooling with fans	Easy to facilitate. Fans widely available.	2x – 3x more energy consumed than other methods. Low effectiveness. Best with other methods.
Fins	Easy and cheap to manufacture.	Add a lot of extra weight to system. Low effectiveness.
Liquid cooling	Very low temperature rise.	Both direct and indirect liquid cooling methods require expert installation. Lack of flexibility in design. Expensive. Possible leakage.
Peltier Effect	Low temperature rise. Not much added weight.	Sensitive electronic parts. Not many sources to study battery applications.
Ice Pack	Easy to obtain ice. Intermediate effectives.	Undecided facilitation. Condensation. Replacing ice regularly.

Chen, D., Jiang, J., Kim, G., Yang, C. and Pesaran, A. (2016). Comparison of different cooling methods for lithium ion battery cells. *Applied Thermal Engineering*, 94, pp.846-854.

Software

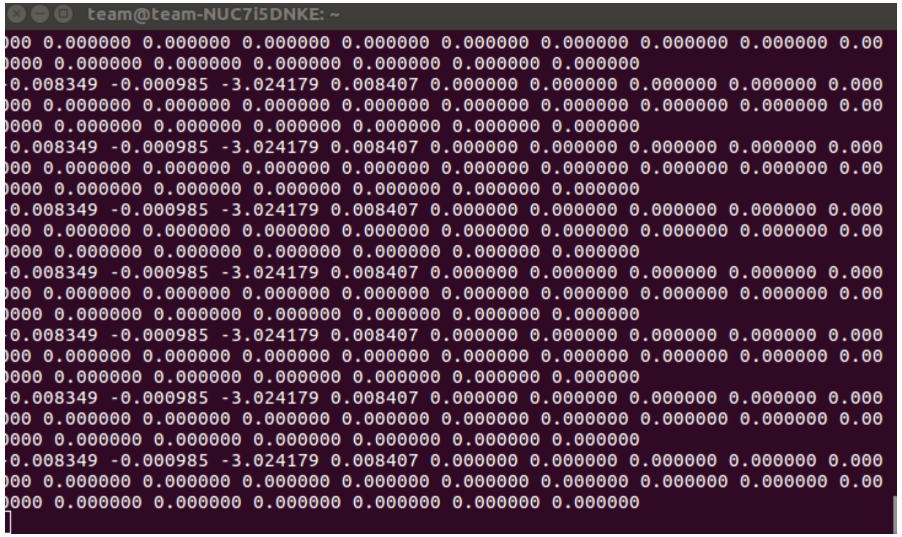
LabView

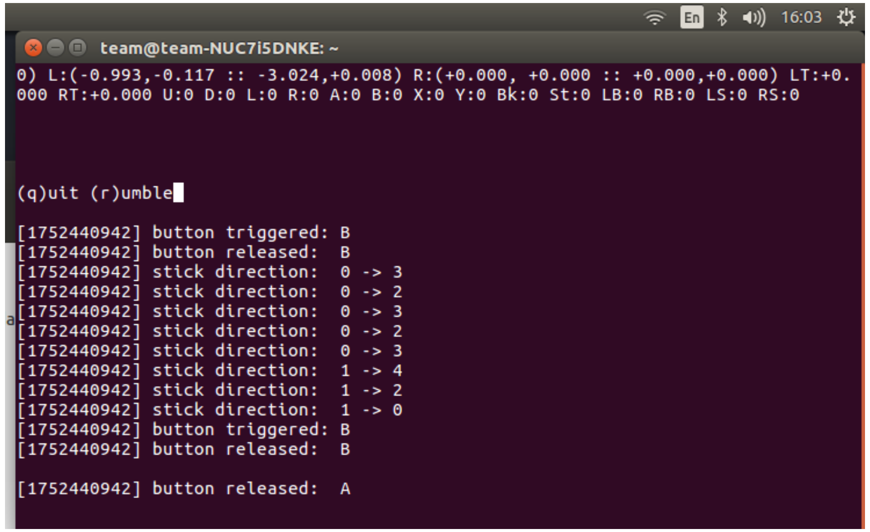
- Connecting MyRio & Computer with wireless way(Complete)
- Draw the graph using the accelerometer value , ON-OFF switch for LED(Complete)
- Study and Coding Labview with MyRIO
- Motor control

ROS

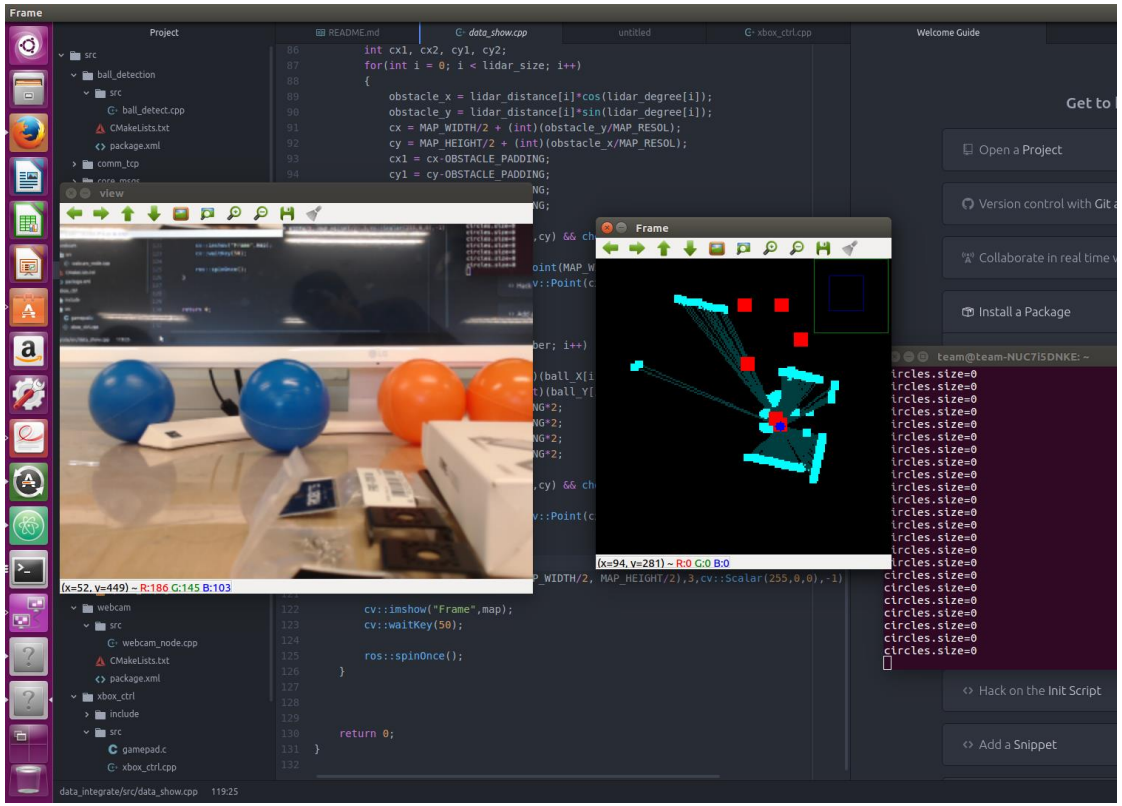
- Learning how to use publisher & subscriber nodes(complete)
- Service & Client with topic communication
- Study Ros launcher

- Master / Slave device with NUC
- Xbox controller connection





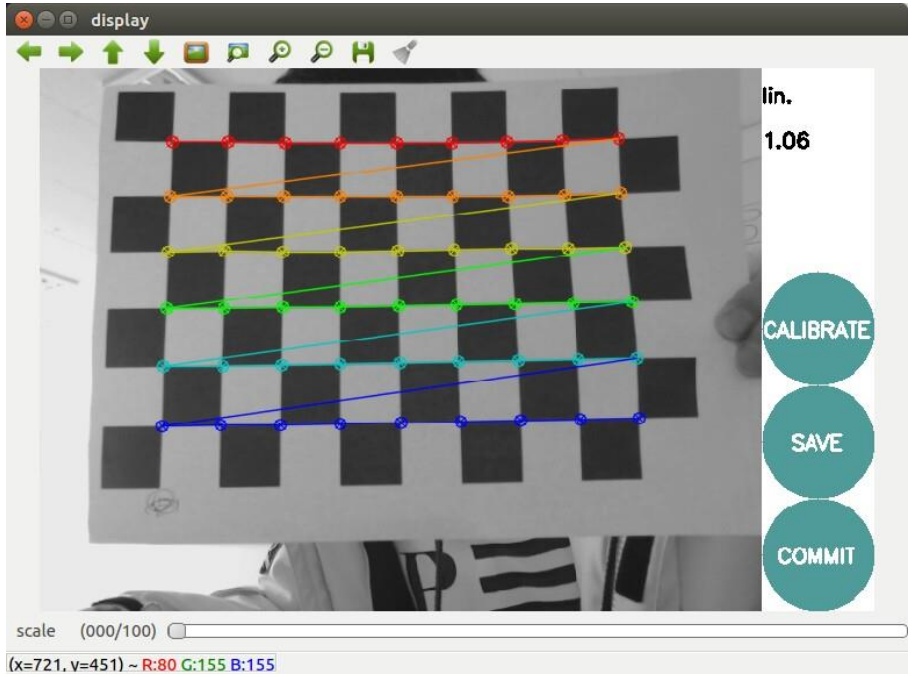
- Lidar and Webcam detection



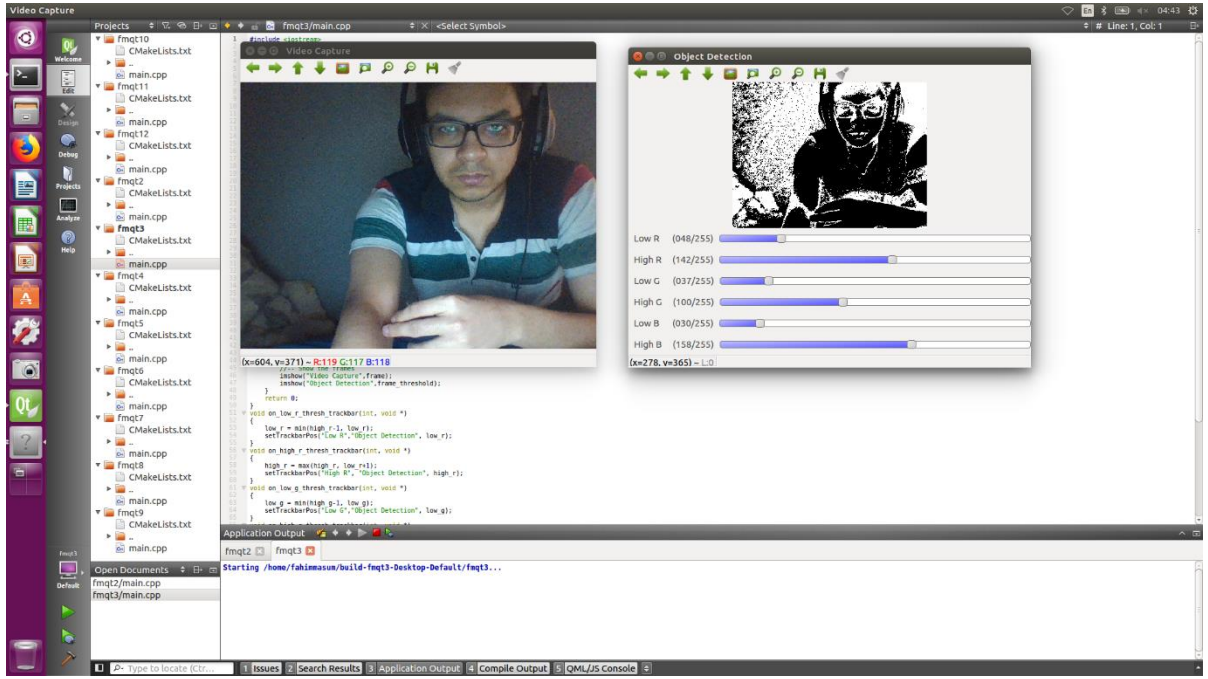
OpenCV

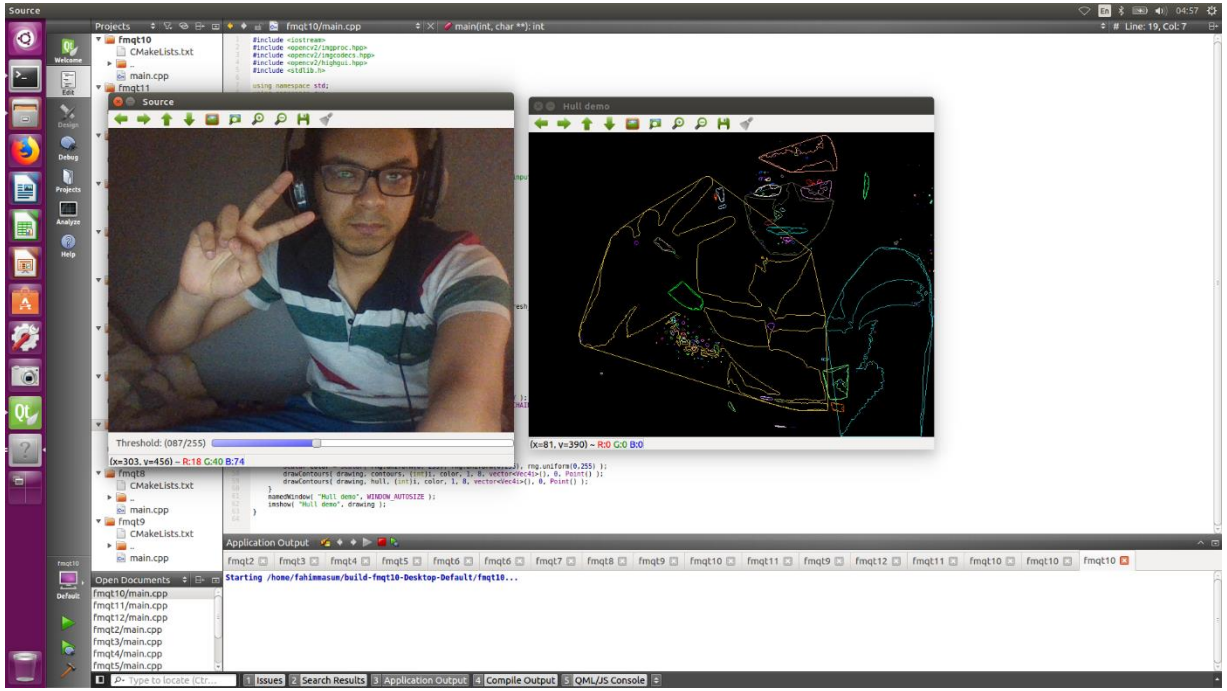
- Installing Ubuntu, OpenCV, and QTCreator.
- Learning basic functionality of Ubuntu and basics of C++.
- Working with webcam.
- Simple programs with QTCreator.

- Camera Calibration
- ROS Installation
- Camera distortion parameter

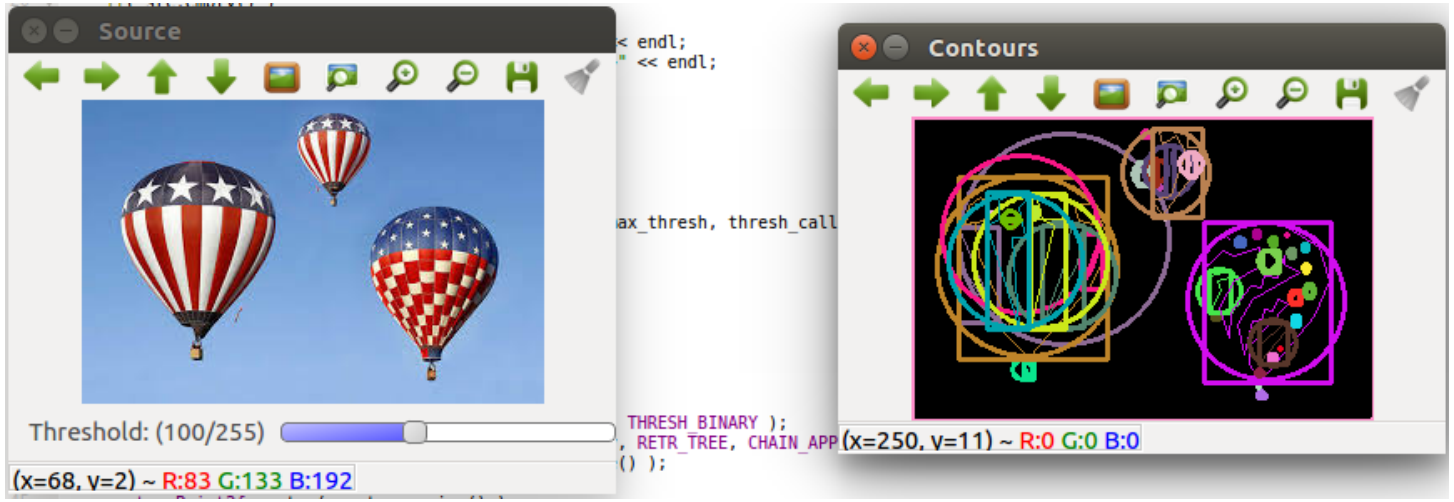


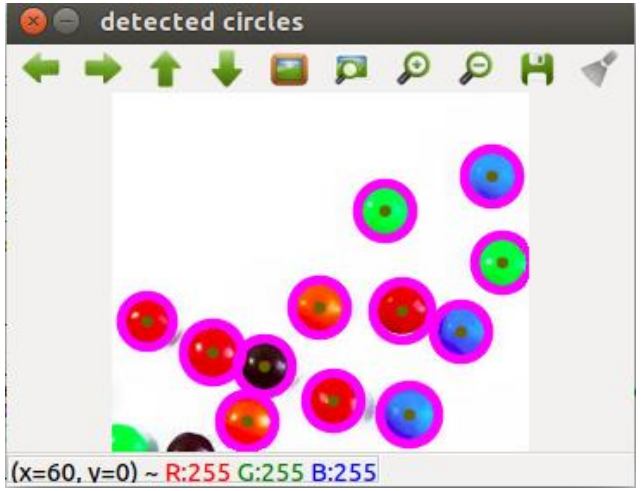
QT

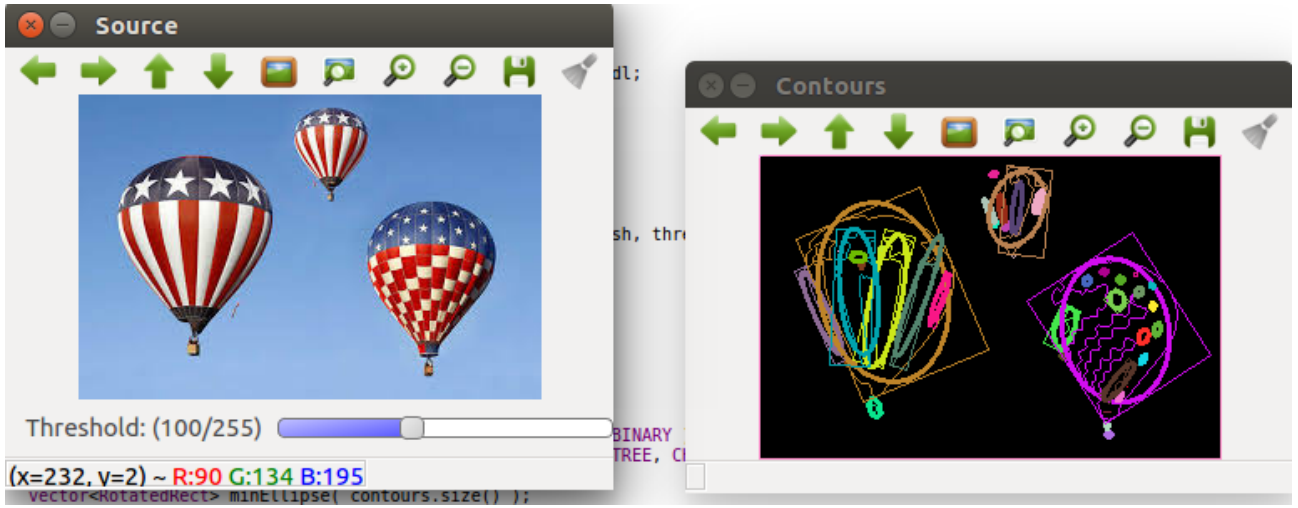

Video Capture
Object Detection
Low R (048/255)
High R (142/255)
Low G (037/255)
High G (100/255)
Low B (030/255)
High B (158/255)


Source
Hull demo
Threshold: (087/255)

QT


Source
Threshold: (100/255)
(x=68, y=2) ~ R:83 G:133 B:192
Contours
(x=250, y=11) ~ R:0 G:0 B:0


detected circles
(x=60, y=0) ~ R:255 G:255 B:255


Source
Threshold: (100/255)
(x=232, y=2) ~ R:90 G:134 B:195
Contours

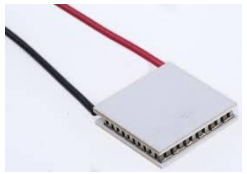
Future plan

- Determine the heat transfer method depending on required power, analytic value and the battery size
- After testing mecanum wheel, design suspension system
- Determine the center of mass depending on materials and configuration

Advice

- FBD for picking method
- Lidar configuration

Decision Matrix for Cooling Systems

Issue: Best method for collecting and depositing		Convection with fins 	Air cooling with fan 	Liquids (oil, water, etc.) 	Ice pack 	Peltier 
Ease	5					
Cost	5					
Weight	20					
Danger	20					
Heat loss	50					


Q
A

Reference

- **Chen, D., Jiang, J., Kim, G., Yang, C. and Pesaran, A. (2016). Comparison of different cooling methods for lithium ion battery cells. *Applied Thermal Engineering*, 94, pp.846-854.**
- https://www.youtube.com/watch?v=bUSAqrHyCuA
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