Capstone Design 1
Team IKOH

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Woo Seok Minwoo Jihye

Contents

PROBLEM DEFINITION

What Is Our Objective?

- **Energy** Mission (30 Points) 
- **Time** Mission (20 Points) 
- **Pick-Up** Mission (30 Points) 

- **Our Mission**:

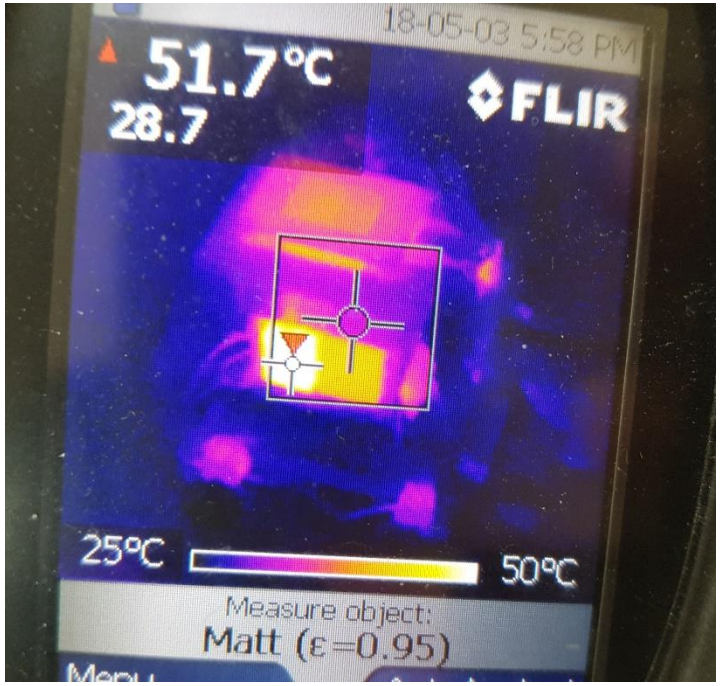
  Develop an **IKOH (efflcient, quicK, errOr-free, Handy) System**

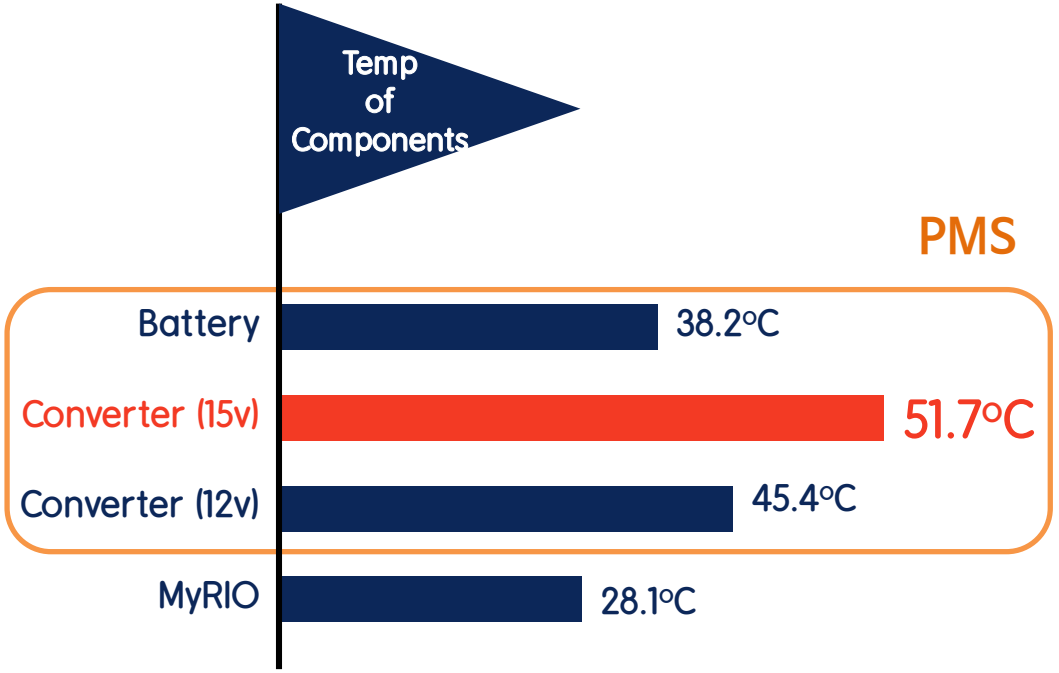

HEAT
TRANSFER

HEAT TRANSFER

Which Component Has the Highest Temperature?

IR Camera Image



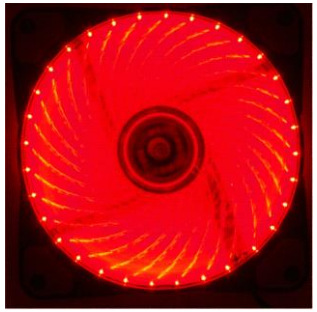


HEAT TRANSFER

How Can We Reduce the Temperature?

Methods

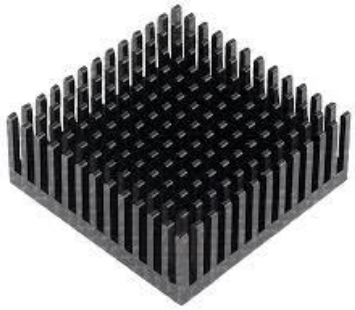
Fan



- Induce Forced Convection

- Why Forced Convection?

Fin



- Increase Surface Area

Thermal Pad

- Reduce Contact Resistance

Forced Convection is 1000 times better!

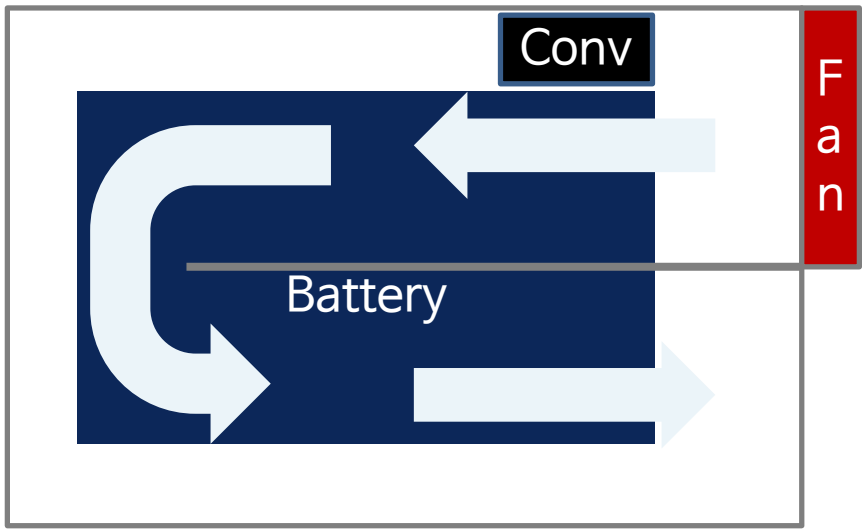
HEAT TRANSFER

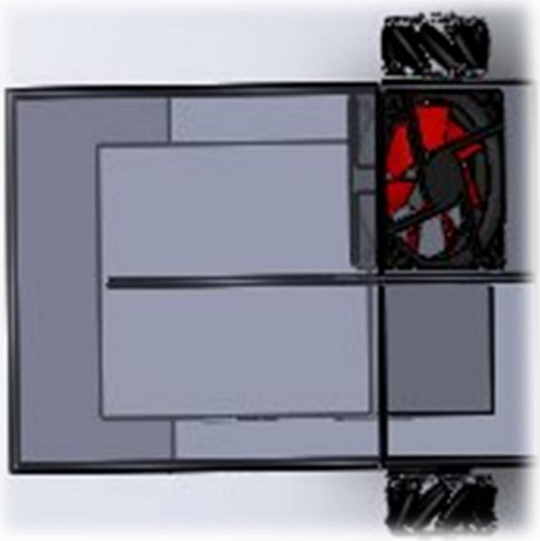
How Can We Cool Efficiently?

Many Surfaces to Cool (Battery (6 sides), Converter)

How can we achieve this with minimum # of Fans?

"ㄷ" Shaped Rectangular Duct





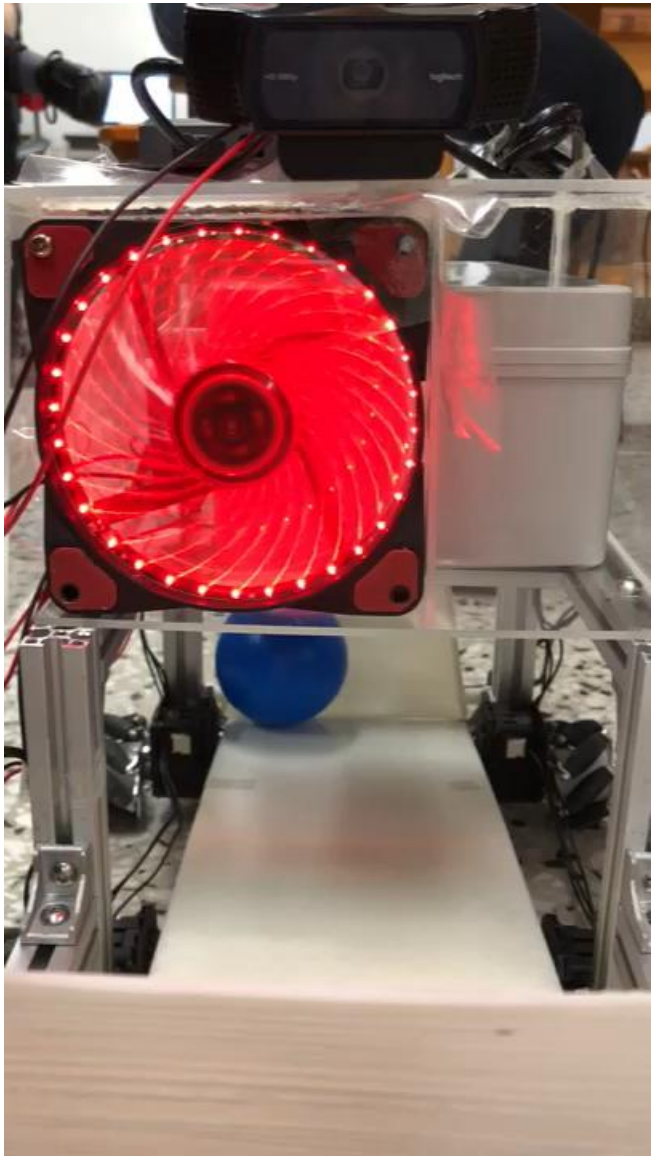
Components Placed In Order Of Temperature

Hottest (Near Entrance) to Less Hot (Near Exit)

→ Minimize Max Temp

HEAT TRANSFER

How Can We Cool Efficiently?




VIBRATION
CONTROL

VIBRATION CONTROL

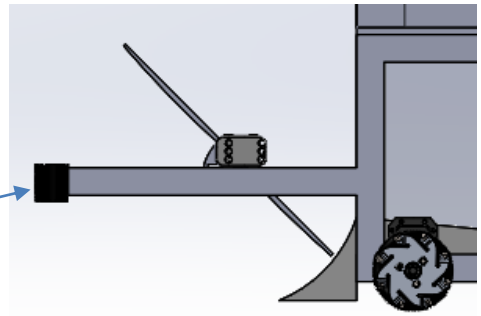
What are the Critical Effects of Vibration?

Inaccurate Camera Ball Detection

Main Causes of Vibration

Unsteady Wheel-Ground Contact

Ball Collecting Fan



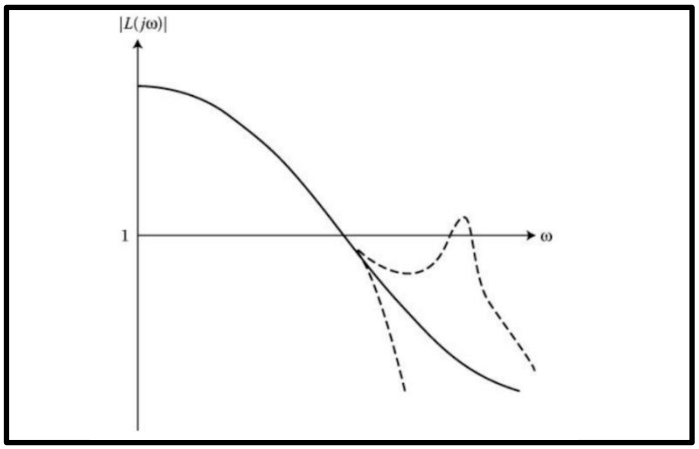
Fan Stops During Ball Detecting Step

Mecanum Wheel

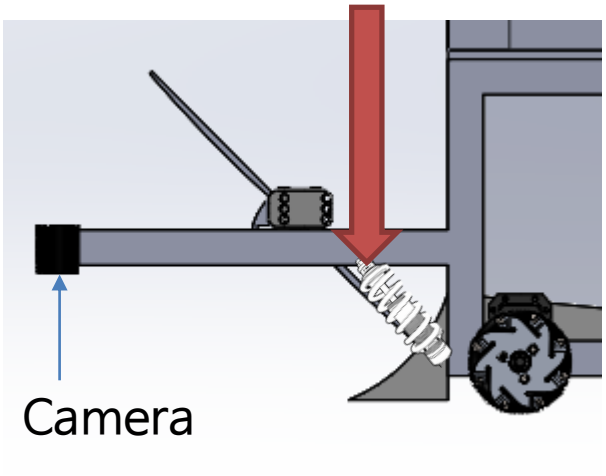
VIBRATION CONTROL

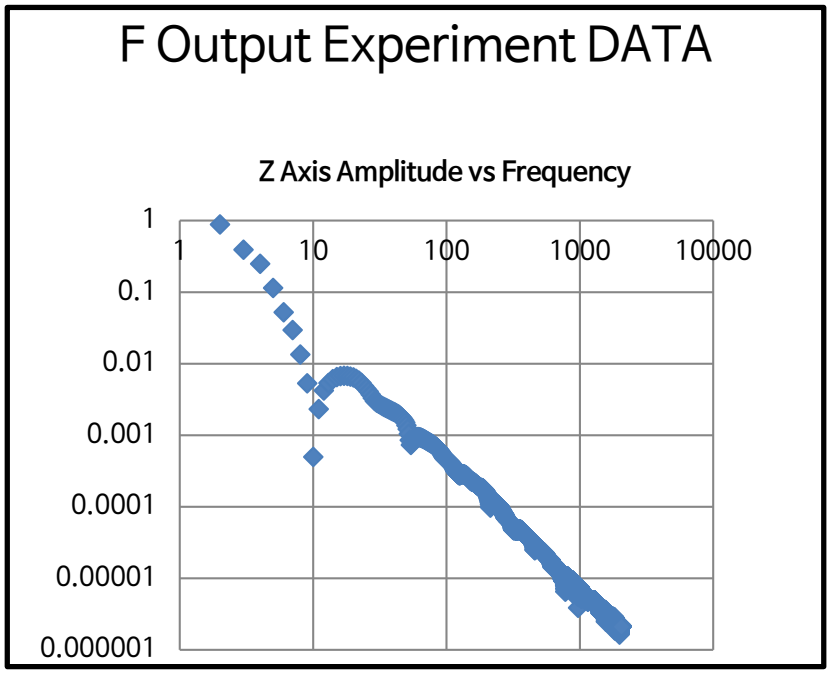
How Do We Control Vibration?

Step 1: Check for Resonance



Step 2: Add Spring-Damper

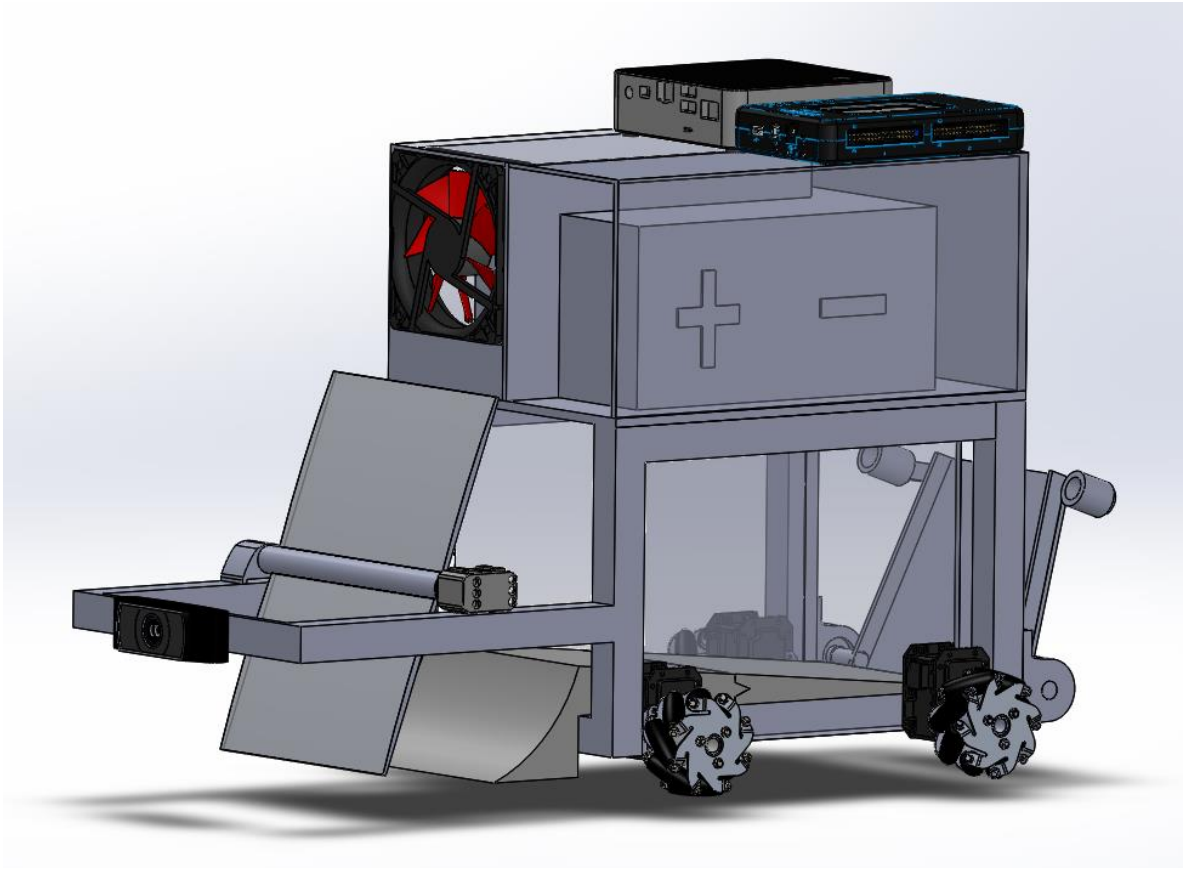




PICK-UP SYSTEM

PICK-UP SYSTEM

Our Ball Picking System



PICK-UP SYSTEM

Our Ball Picking Mechanism

High Ball Picking Speed

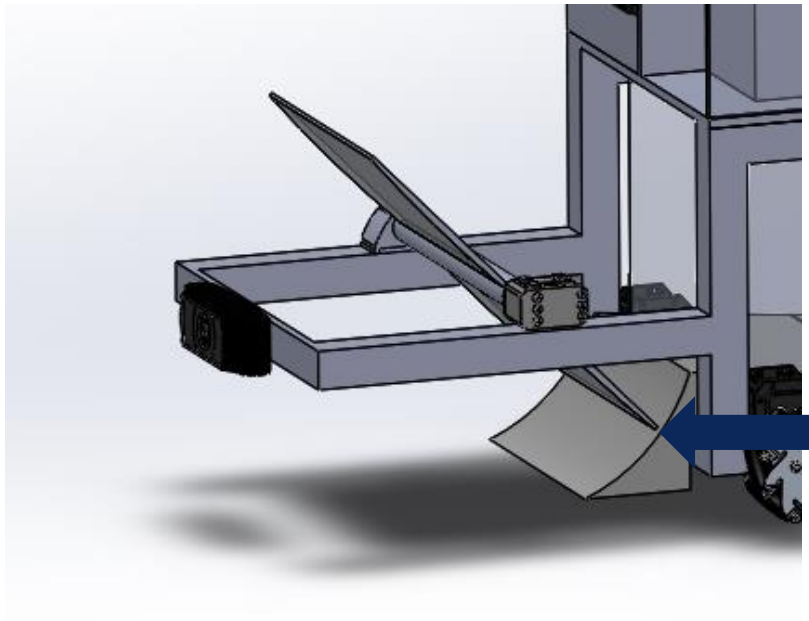
Easy to Control

High Ball Picking Accuracy

Easy to Manufacture

3

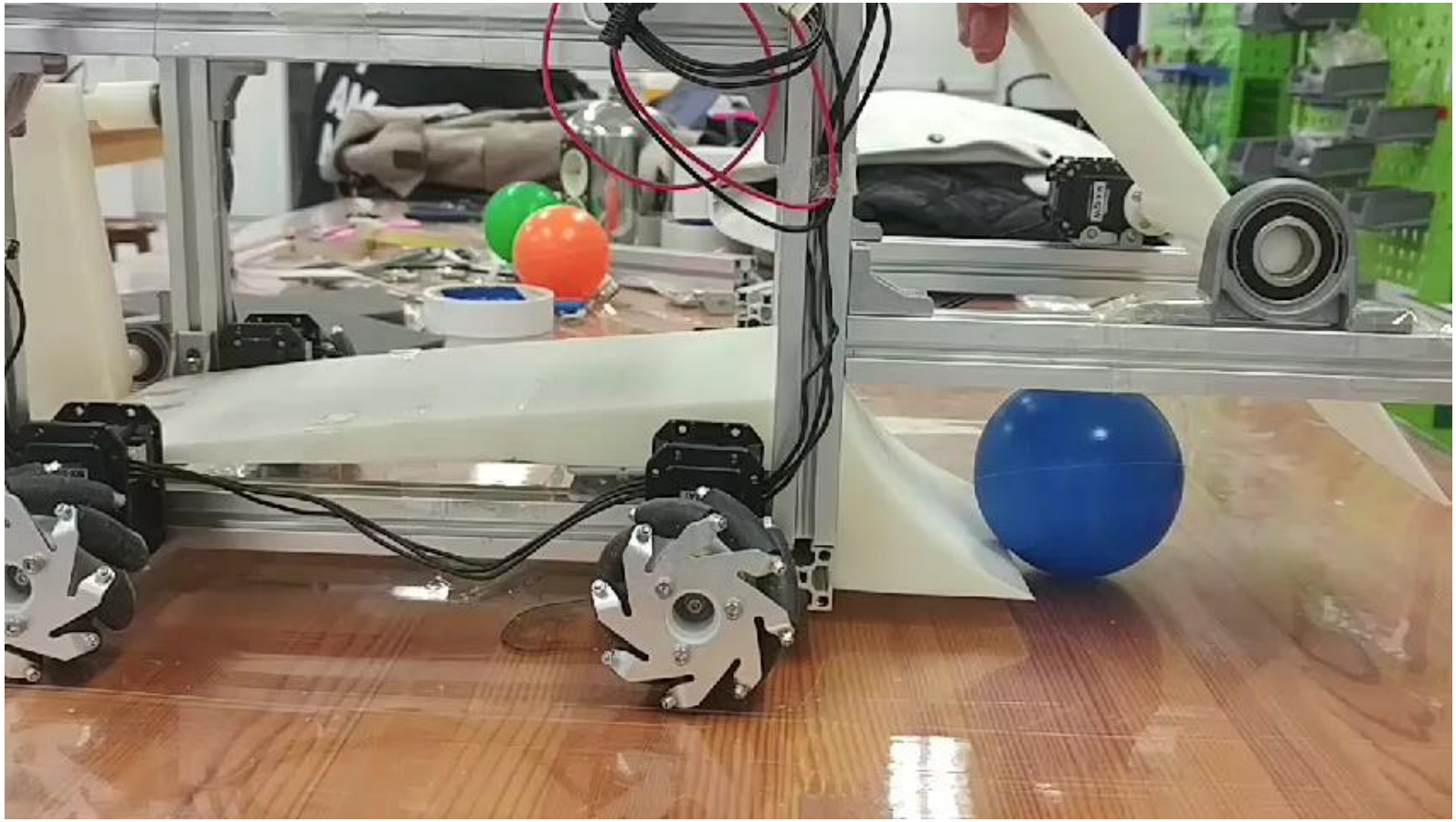
PICK UP SYSTEM



Curved Incline Fits Blade Trajectory

PICK-UP SYSTEM

Our Ball Picking Mechanism

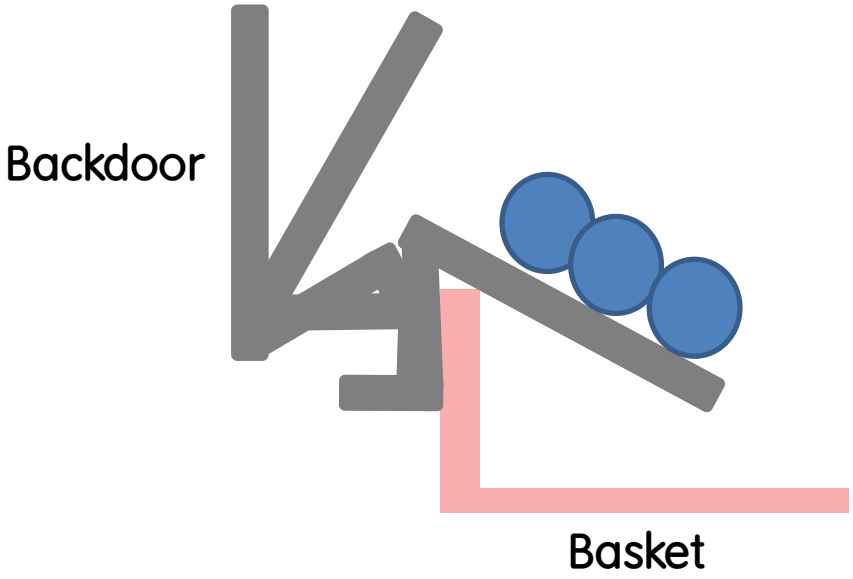


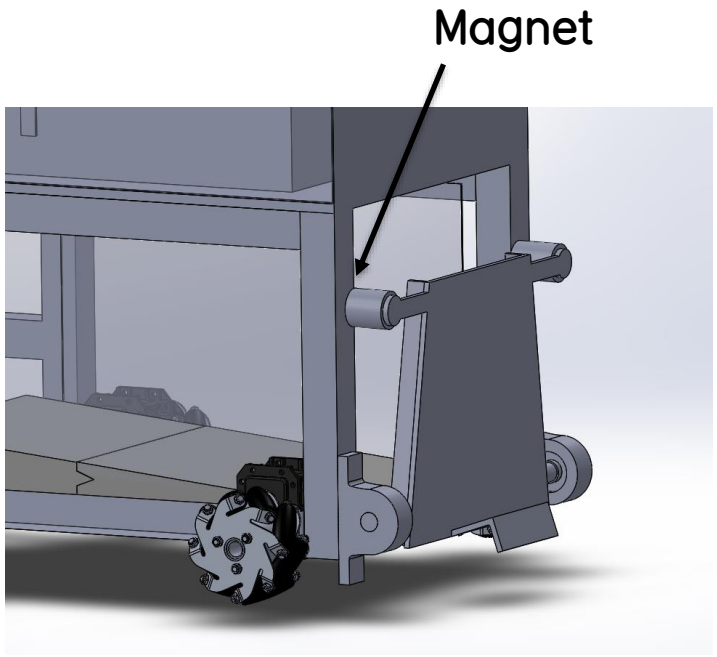
PICK-UP SYSTEM

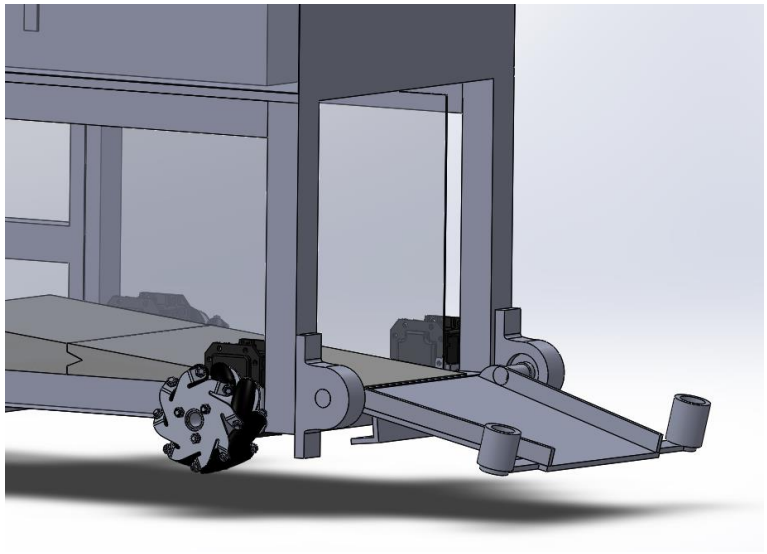
Our Ball Releasing Mechanism

Non Actuator Mechanism

Cost is important in Engineering!

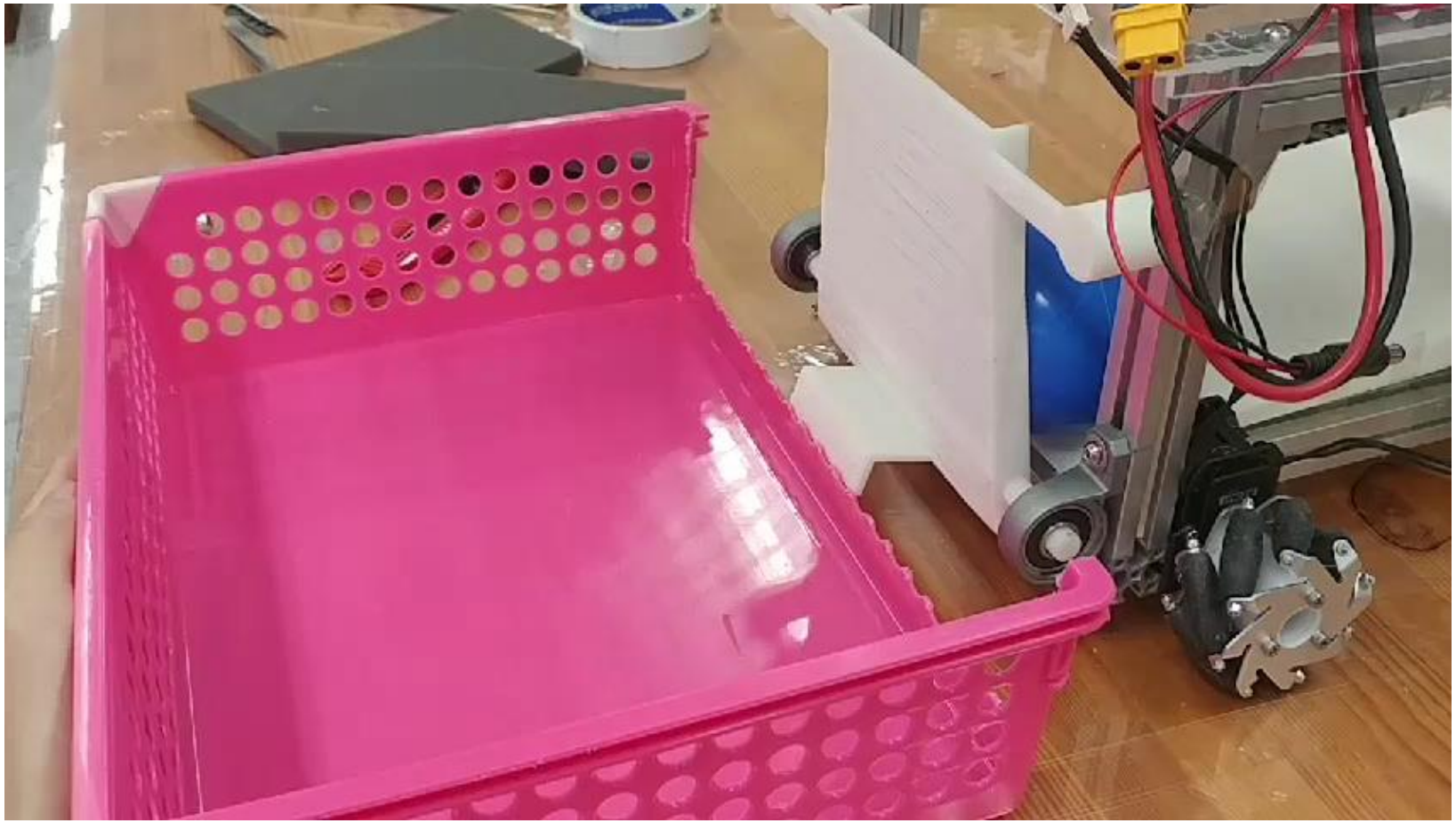






PICK-UP SYSTEM

Our Ball Releasing Mechanism

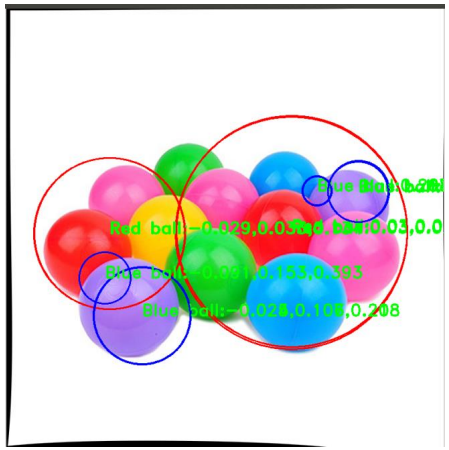



VISION
PROCESSING

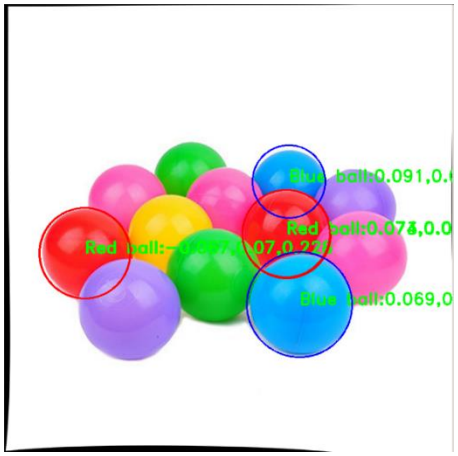
VISION PROCESSING

Vision Recognition

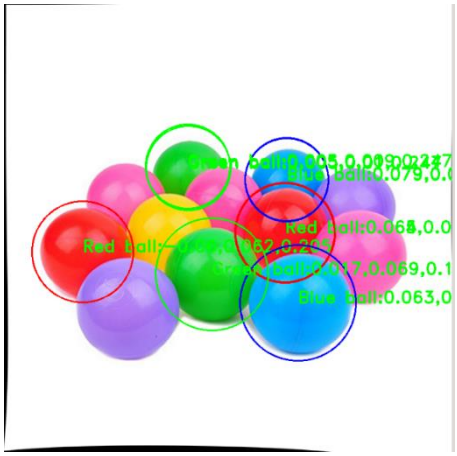
Initial



..Processing..



Final

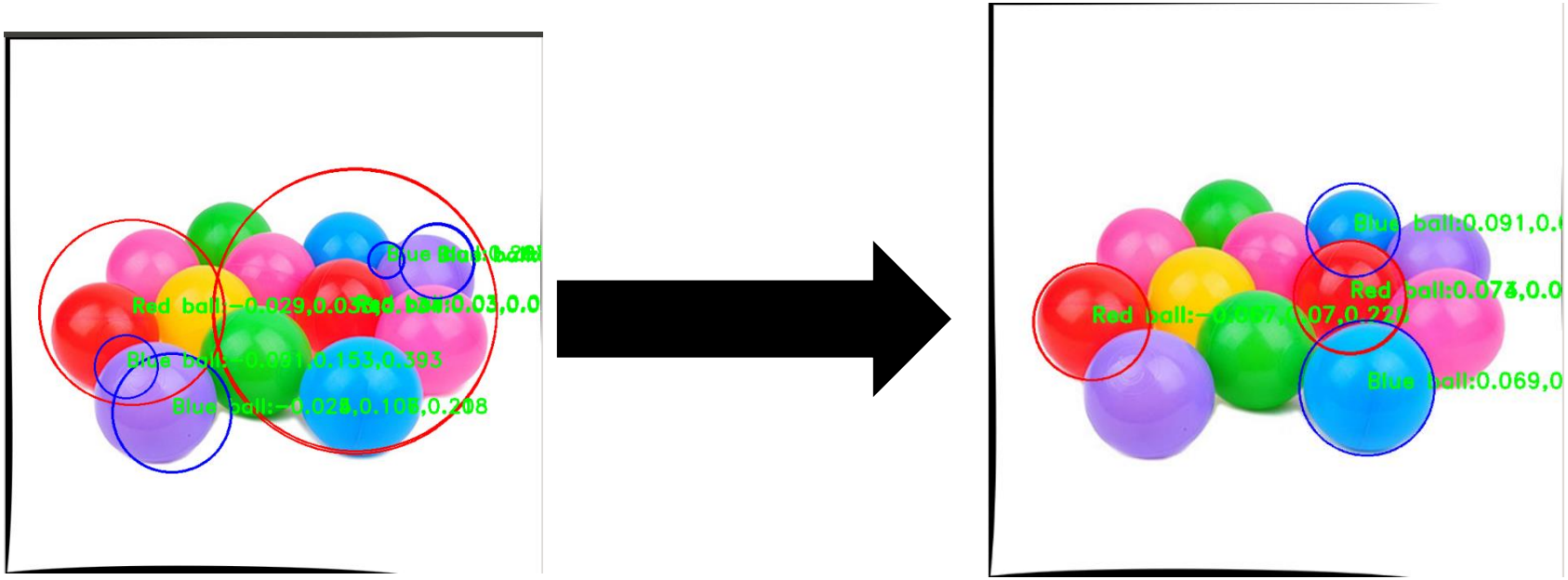


- Alter HSV values
- Optimize morphological values
- Add green balls

VISION PROCESSING

HSV Fitting

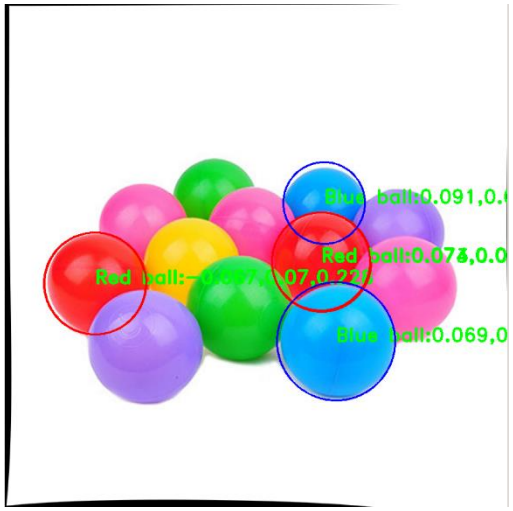
⇒ Alter HSV values to fit condition

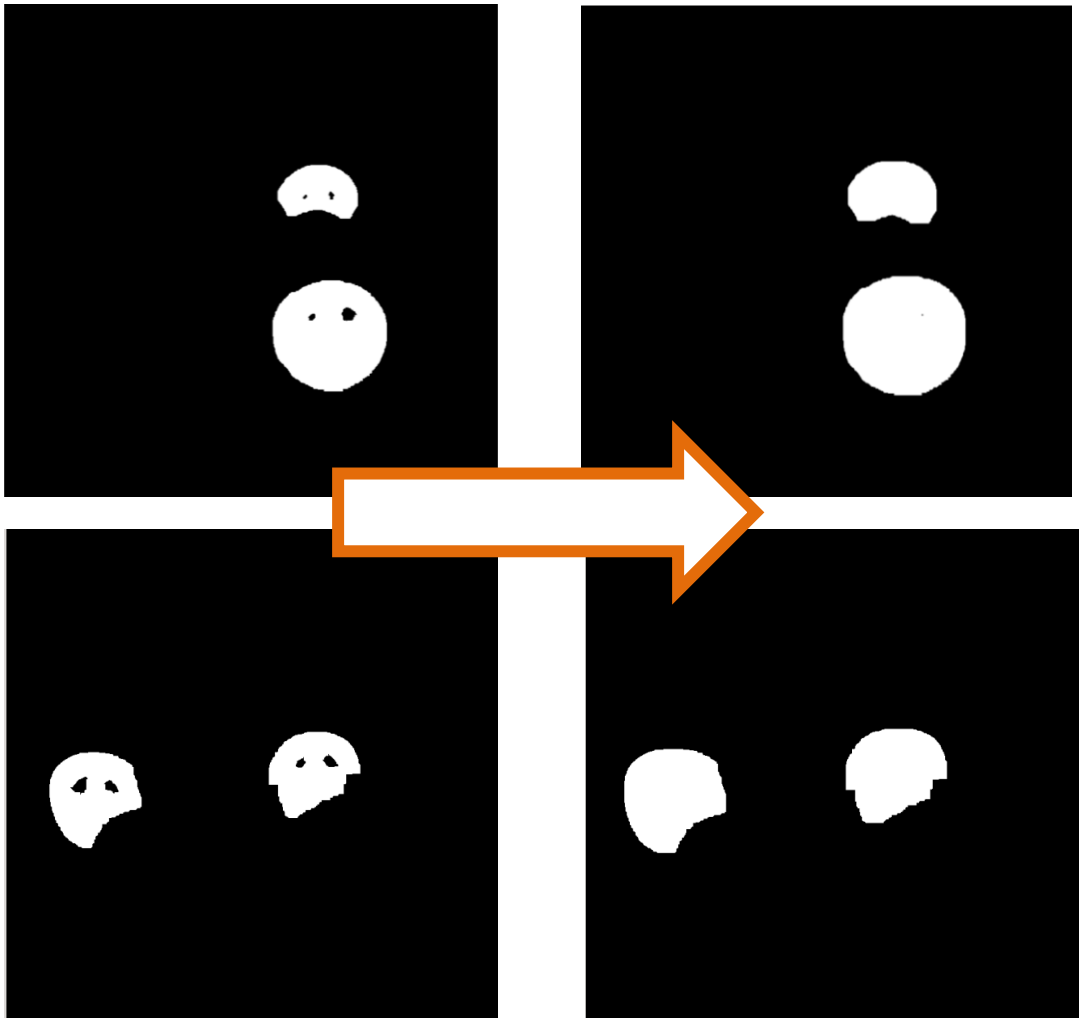


VISION PROCESSING

Morphology

⇒ Dilate image through morphological process (widen "white" area)

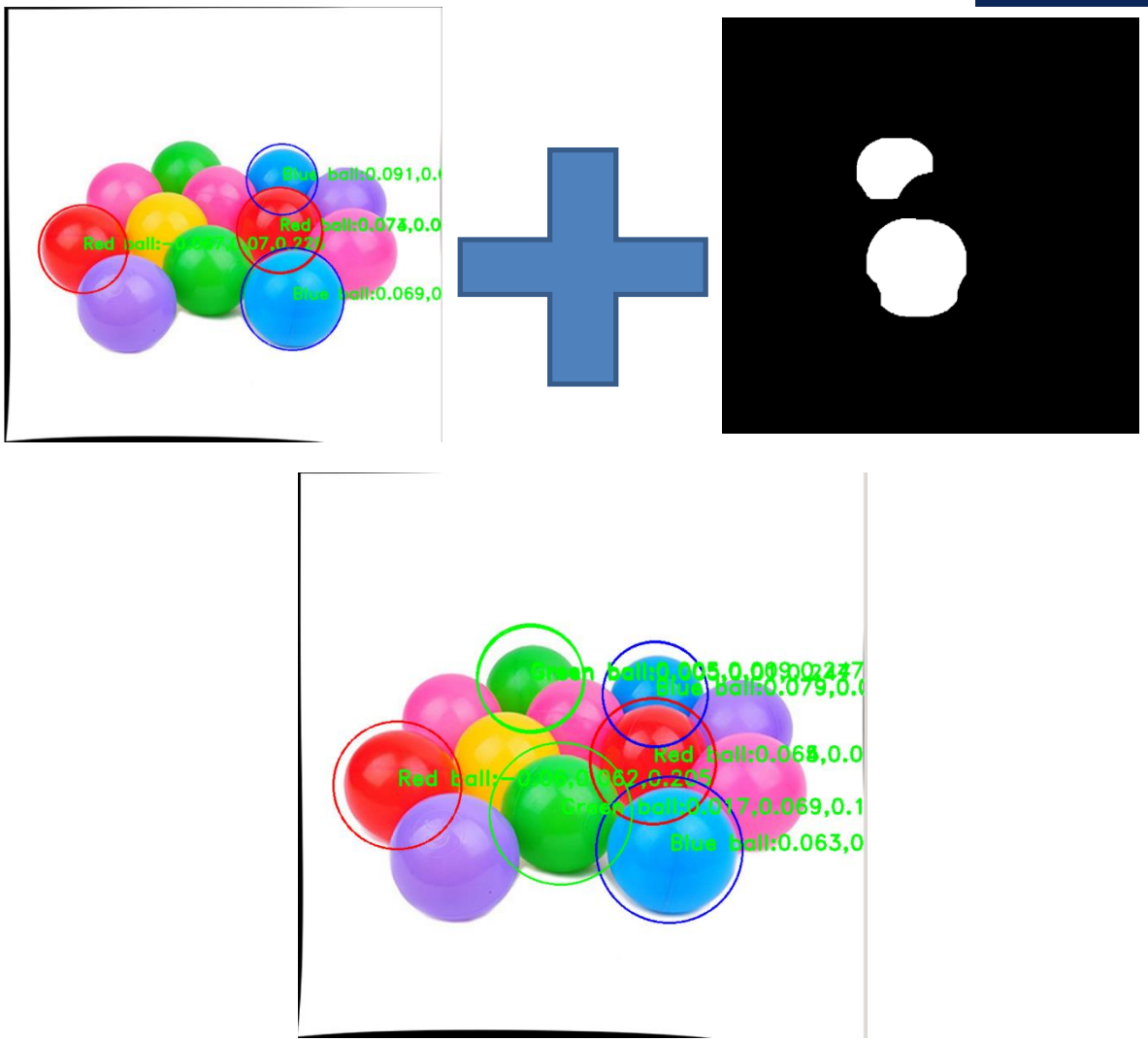




VISION PROCESSING

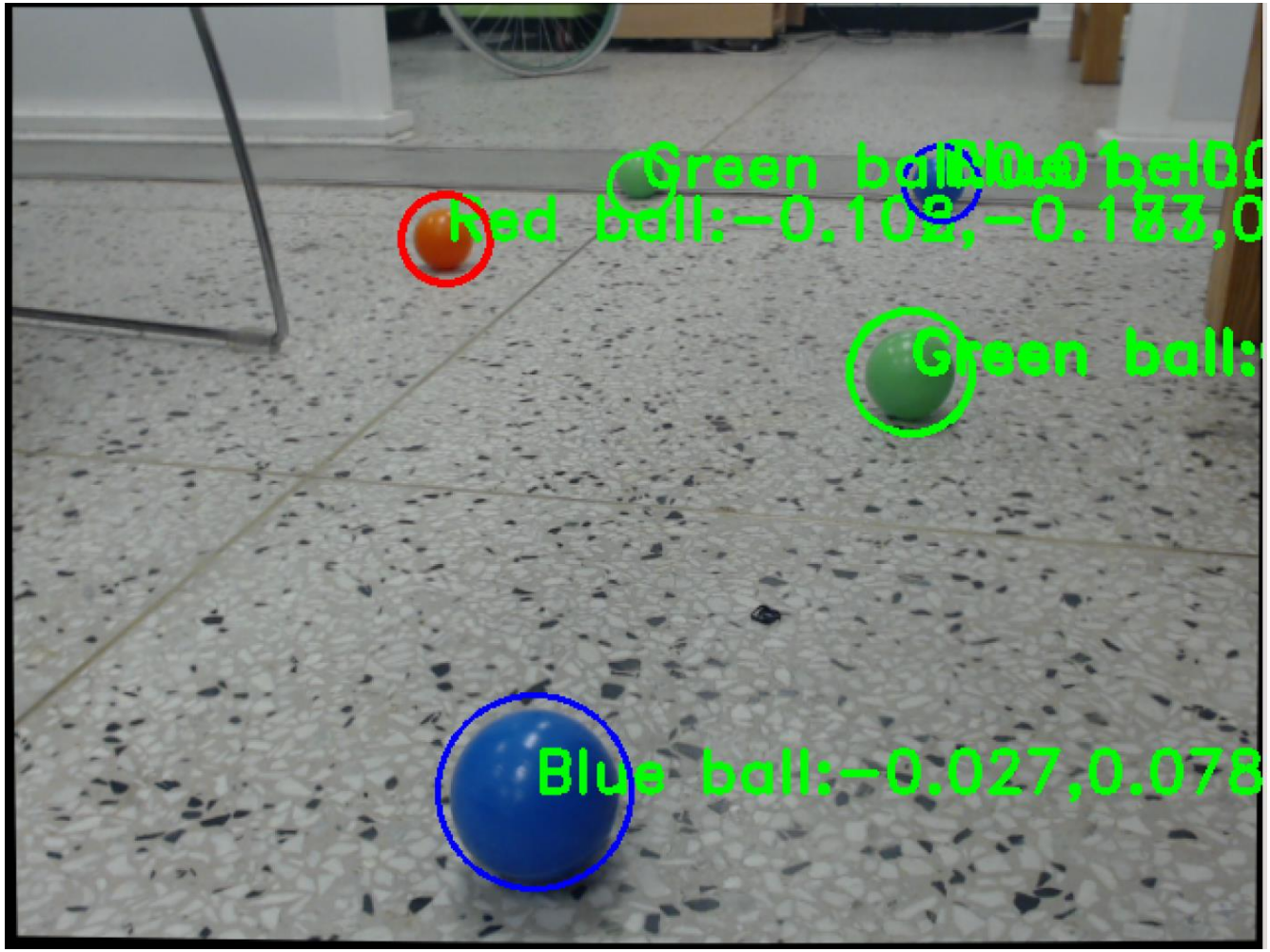
Detect basket

⇒ Add green ball(basket)



VISION PROCESSING

Actual Recognition

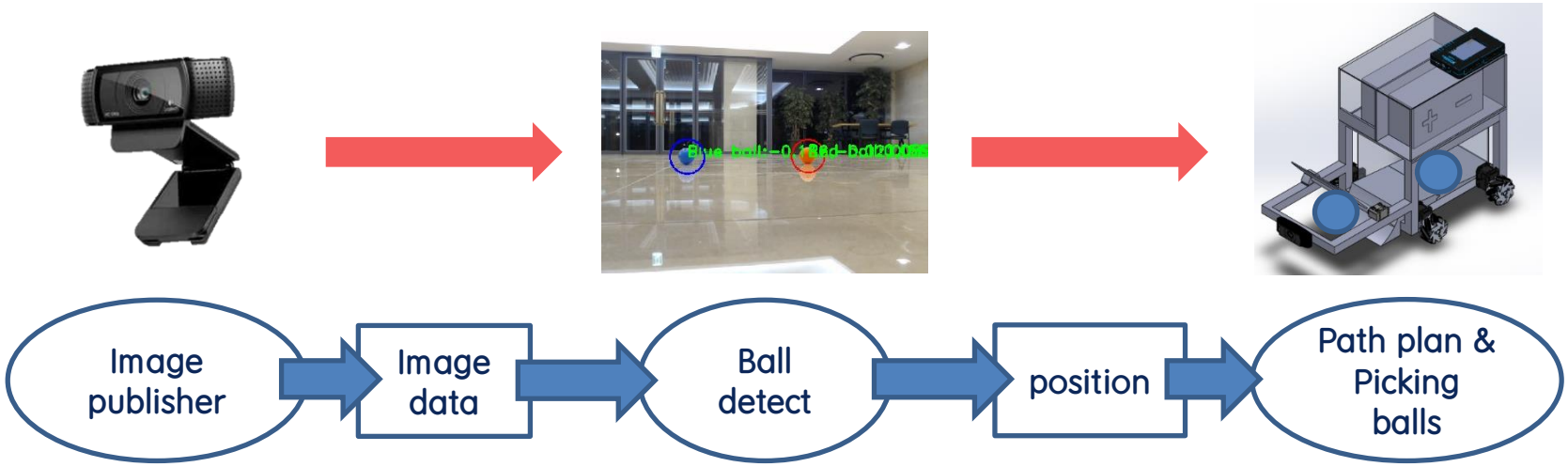


Actual recognition (in Capstone room)


ROS
INTEGRATION

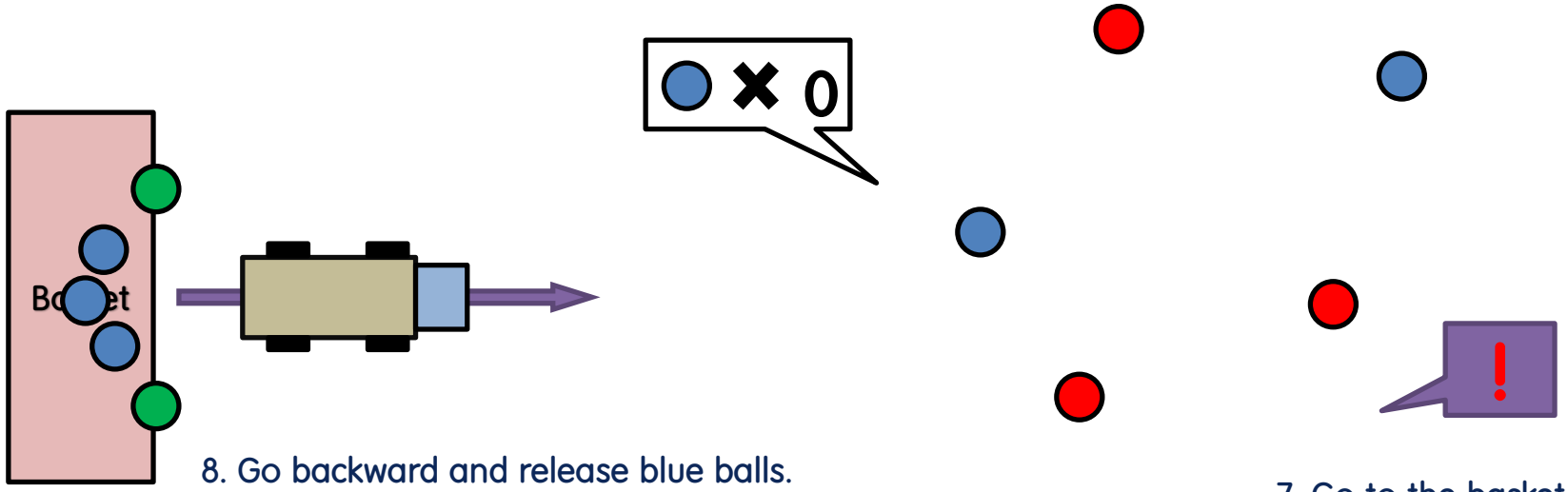
ROS INTEGRATION

Overall System Mechanism



ROS INTEGRATION

Ball Picking Algorithm



8. Go backward and release blue balls.

7. Go to the basket and turn 180˚

4. Repeat three times, until all three blue balls are collected

3. Pick the ball and scan a new blue ball turning CCW

6. If there is no blue ball in field, detect the green ball(basket)

2. Turn toward and approach to the ball (if there are any red balls on the path, avoid)

1. Turn CCW, detect the rightmost ball among the blue balls

5. Scan the field whether there is no blue ball left

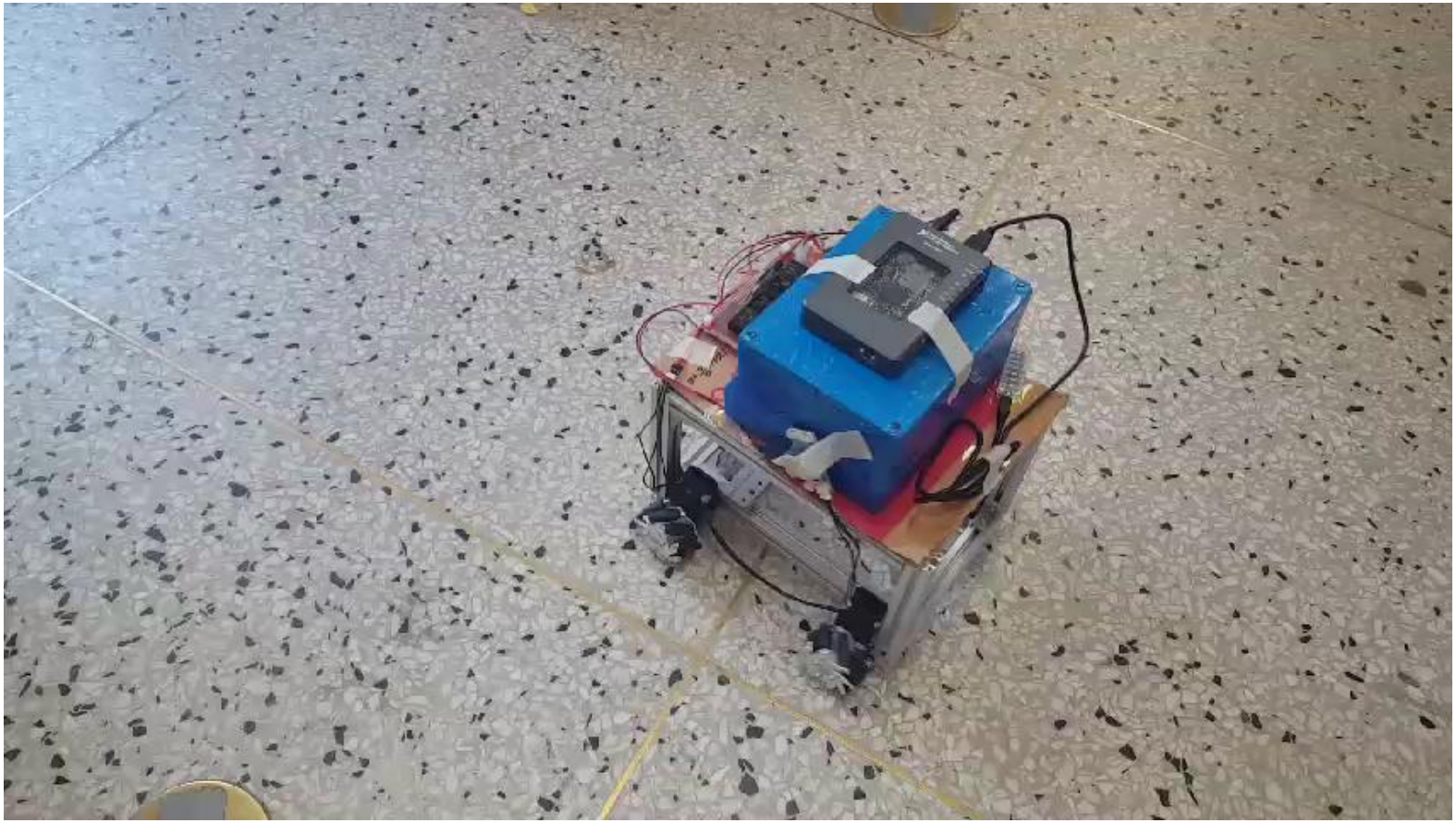
ROS INTEGRATION

XBOX Control

XBOX Control

ROS INTEGRATION

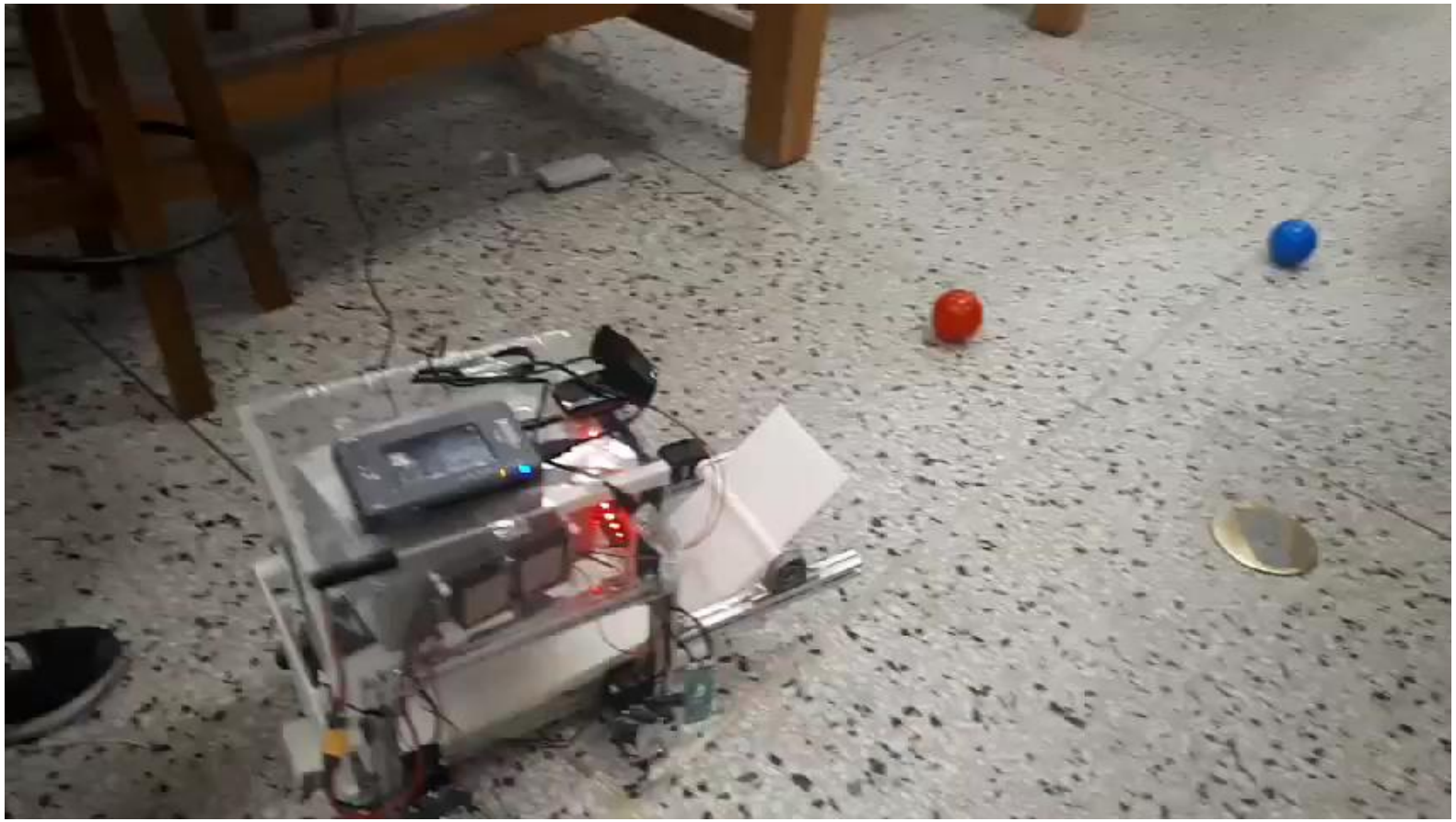
ROS Automatic Control



Inputs to move in various directions every 2 seconds

ROS INTEGRATION

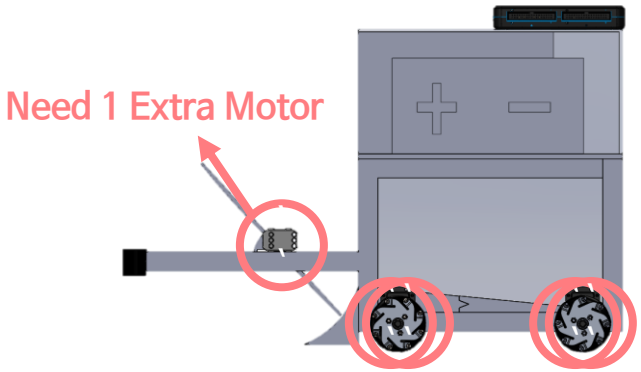
Ball Picking Algorithm

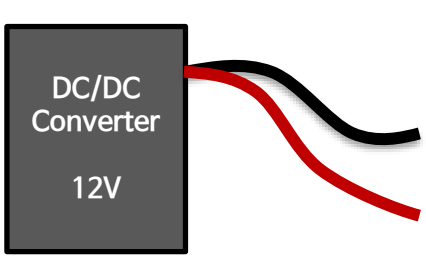



MOTOR
CONTROL

MOTOR CONTROL

Motor Specification





X 4

X 1

MX-28AT
(No load speed : 55rpm at 12V)

MX-12W

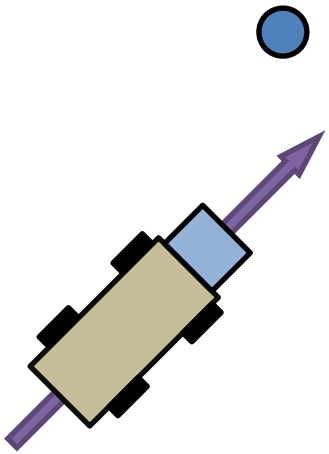
Torque ↓

Speed ↑

Cost ↓

MOTOR CONTROL

Receiving Data



Target position & angle

ROS

Wheel Velocity

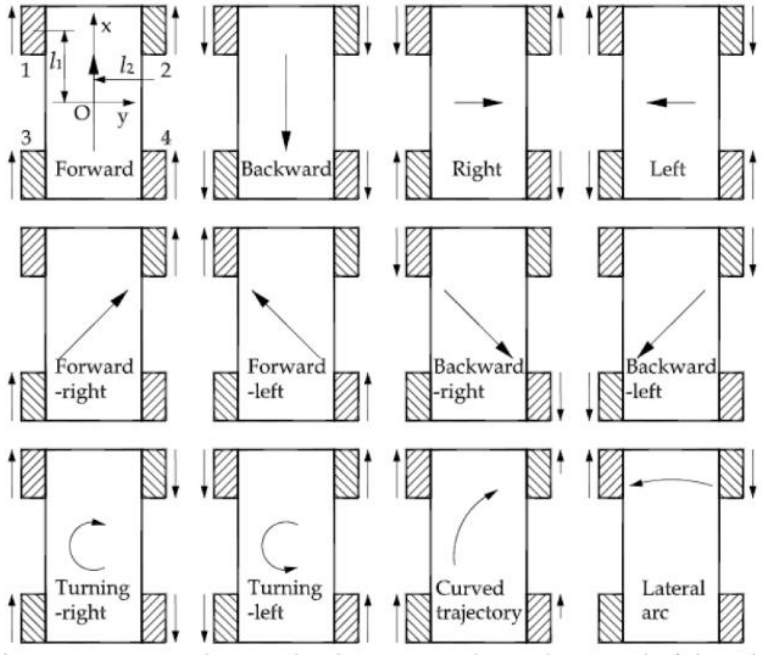
LabVIEW ?

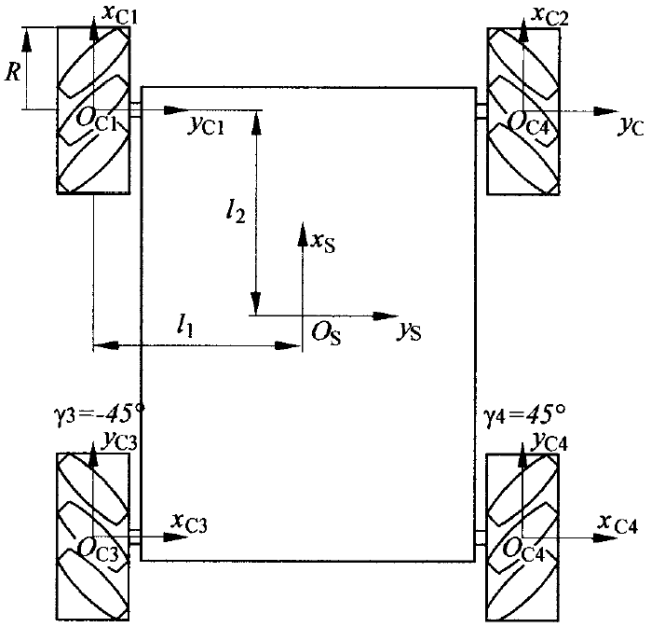
Motor inputs

Dynamixel

MOTOR CONTROL

Wheel Kinematics





$$\begin{bmatrix} v_x \\ v_y \\ \omega_z \end{bmatrix} = \frac{R}{4} \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -1 & -1 & 1 \\ -\frac{1}{l_1+l_2} & \frac{1}{l_1+l_2} & -\frac{1}{l_1+l_2} & \frac{1}{l_1+l_2} \end{bmatrix} \cdot \begin{bmatrix} \omega_1 \\ \omega_2 \\ \omega_3 \\ \omega_4 \end{bmatrix}$$

Inverse matrix

$$\begin{bmatrix} \omega_1 \\ \omega_2 \\ \omega_3 \\ \omega_4 \end{bmatrix} = \frac{1}{R} \begin{bmatrix} 1 & 1 & -(l_1+l_2) \\ 1 & -1 & l_1+l_2 \\ 1 & -1 & -(l_1+l_2) \\ 1 & 1 & l_1+l_2 \end{bmatrix} \cdot \begin{bmatrix} v_x \\ v_y \\ \omega_z \end{bmatrix}$$

4 STRENGTHS of IKOH

0

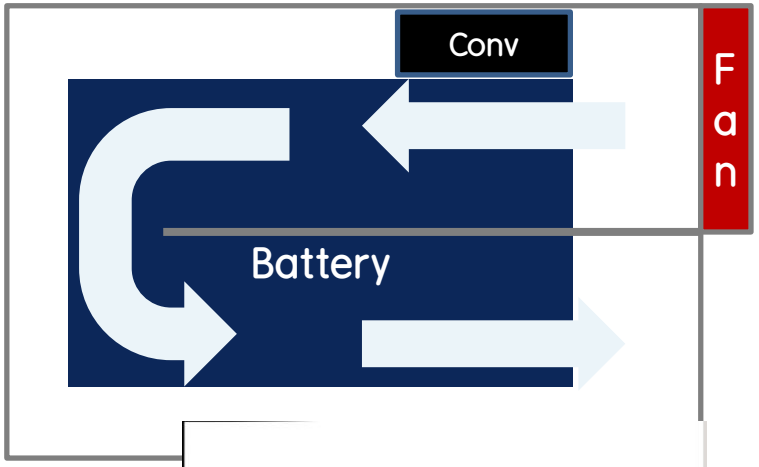
Additional

1. Smart Heating System (Duct)

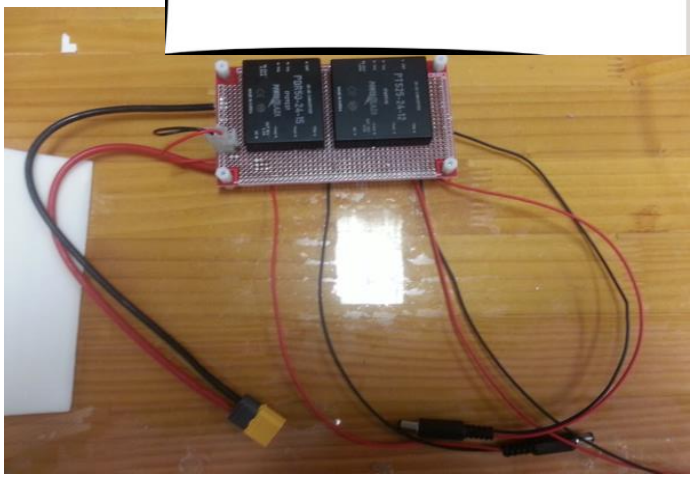
2. Non-Actuator Mechanism

3. Compact Soldering

4. Precise Image Processing



Backdo




THANK YOU
FOR LISTENING