# Project Proposal

Team X- Tumbler

13.06.2020

01

## Line Following

Line following strategy including sensors, hardware design, Algorithm and etc.

02

## Wall Following

Wall following strategy including sensors, hardware design, Algorithm and etc.

03

## Color detection

Robot arm working principle including color detection strategy with sensors, actuators and etc.

04

## Ramp

Strategy for passing Ramp successfully and robot control

05

## Gates

Strategy for identifying the gate sequence and passing two gate

# Wall Following
# Pole Detection
# &
# Box Detection

# 02

Strategy including sensors, hardware design & Algorithm

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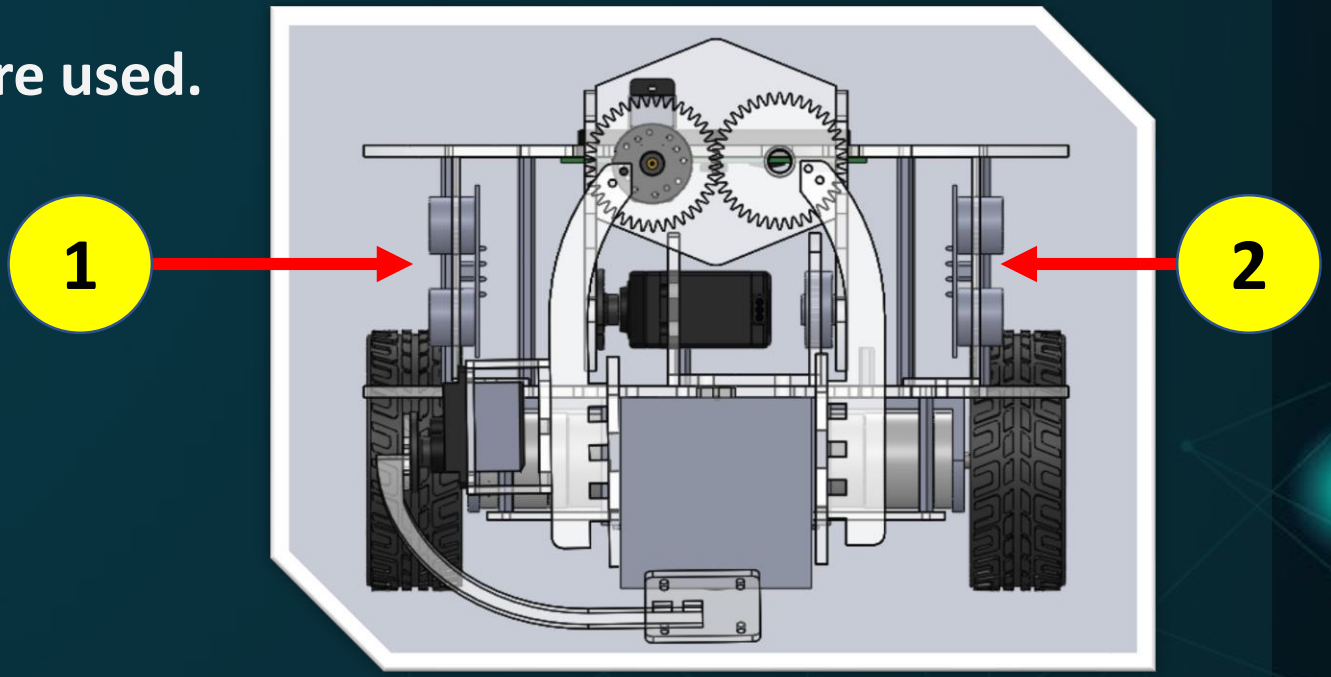
# Wall Following & Pole Detection

[] Two Ultra Sonic (SRF 05) sensors are used.


[] Uses time of flight principle
[] Has a good accuracy → enough for our purpose
[] Cheap
[] Easy to control
[] Good range of measuring → Has a range of 3cm to 4m & operate frequency range of 40-60 kHz.

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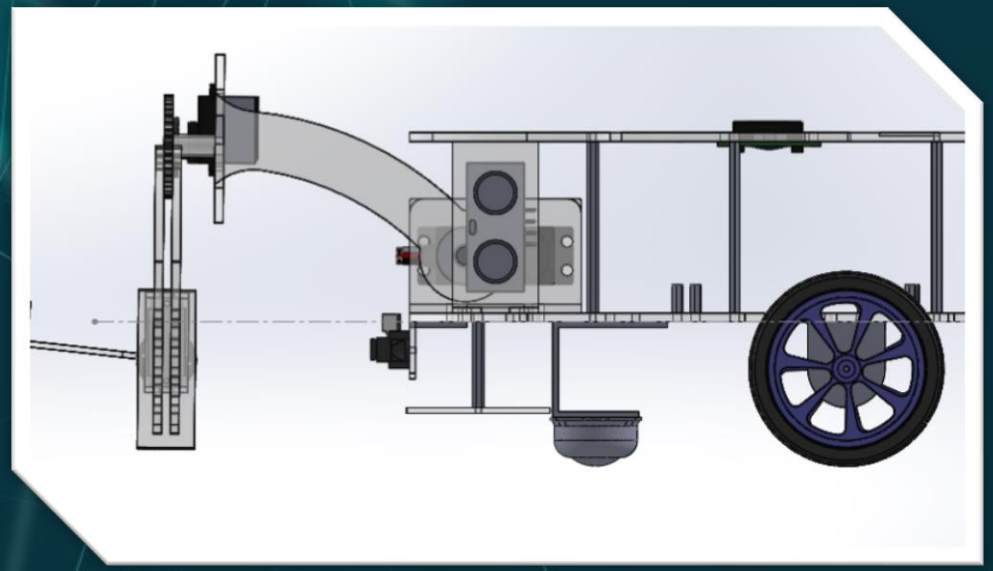
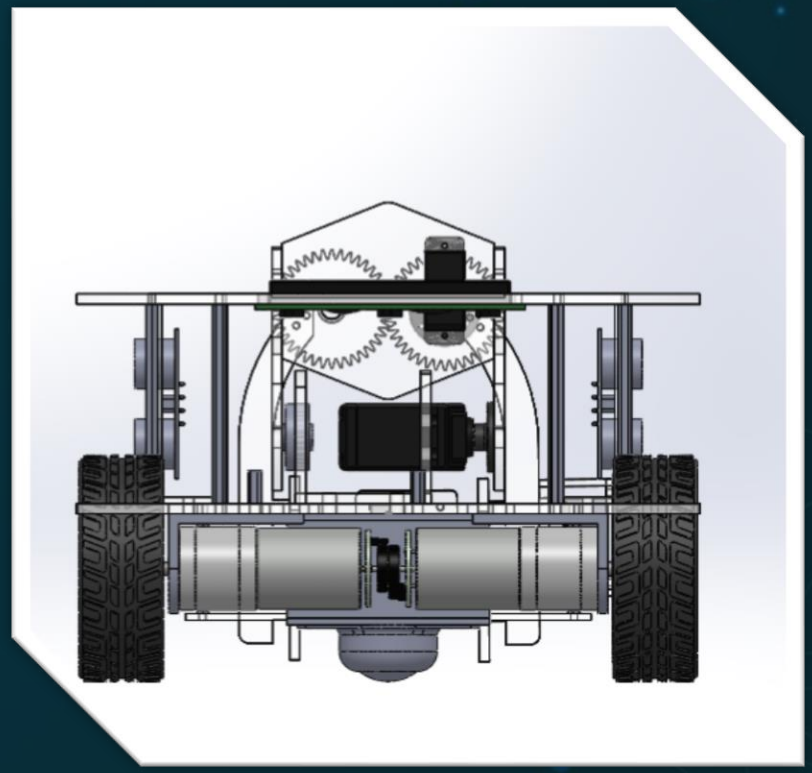
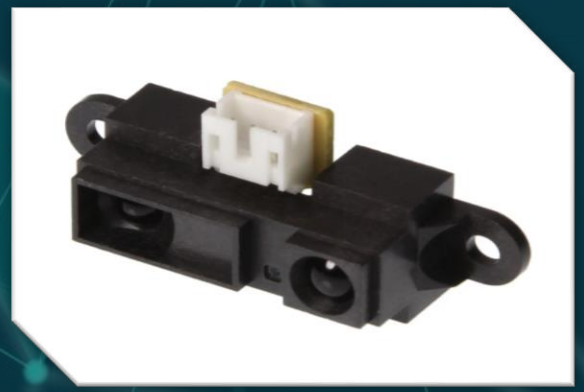
- [] Calculate the distance between the wall and sensor. As well  used to count the number of poles.
- [] As there are two curved walls, we planned to detect each wall by left/right or using both sensors.
- [] Signals that given by  the sensors are send to the Arduino board and then speeds of motors will be controlled.

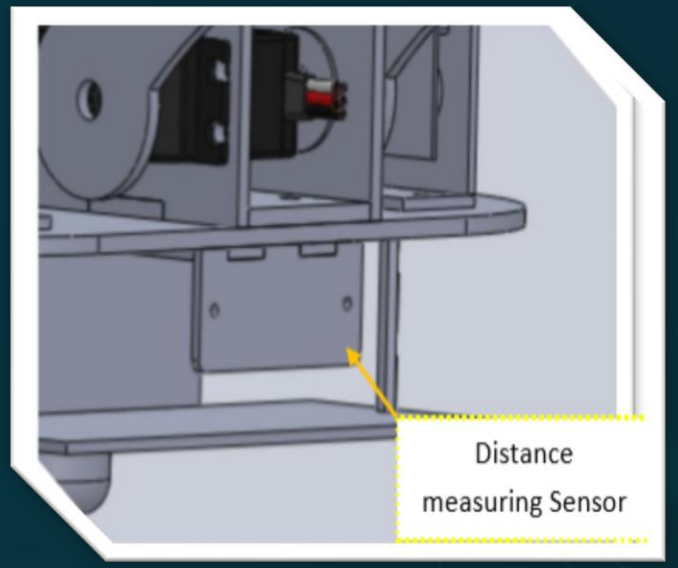


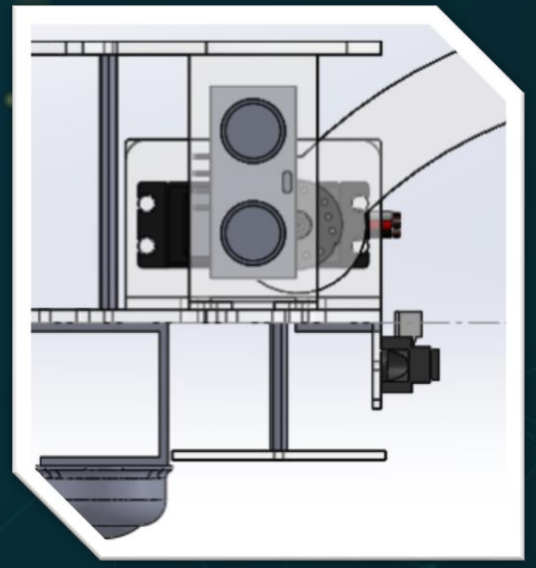


# Box Detection

[] SHARP GP2Y0A21 IR sensor is used.



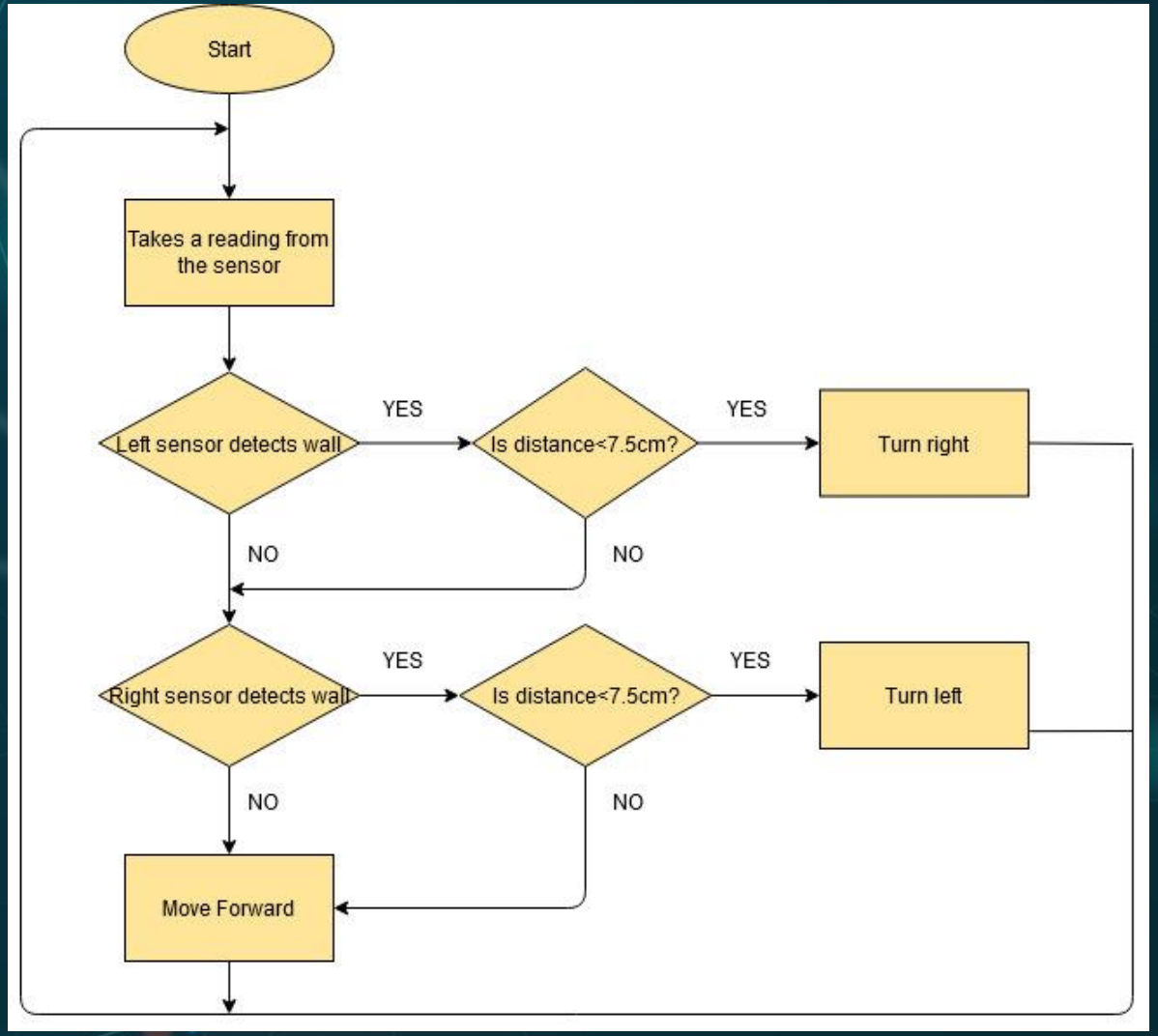


I Uses incident angle principle
II More accurate
III High speed response rate

[] The sensor reading will be used to calculate the specific distance between the robot and the box where the robot will have to stop for color detection task.
[] IR sensors measures infrared light radiating from objects in its field of view.

# Wall Following Algorithm



# Robot Brain

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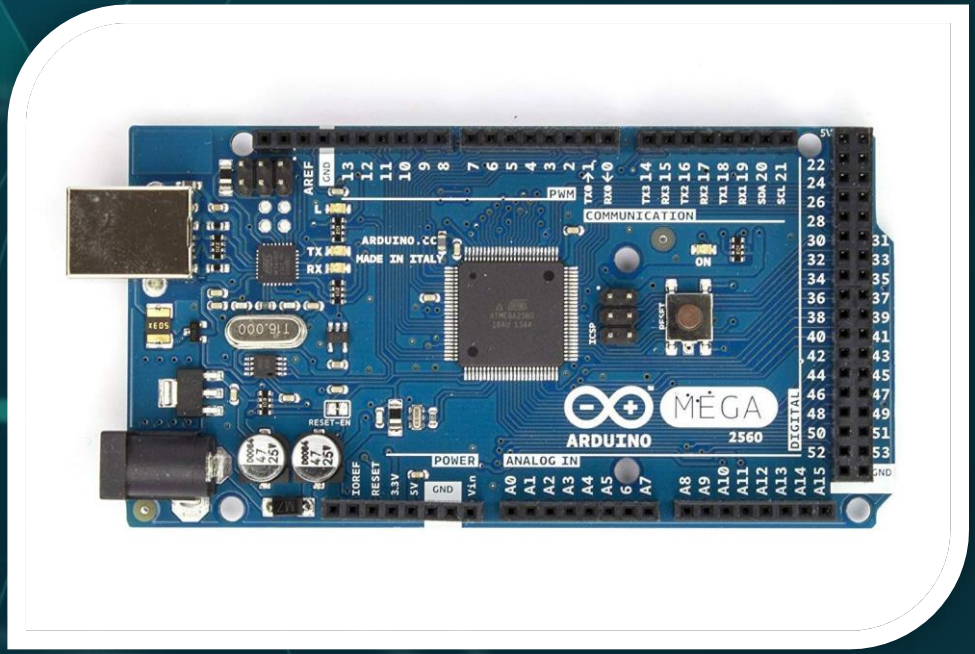
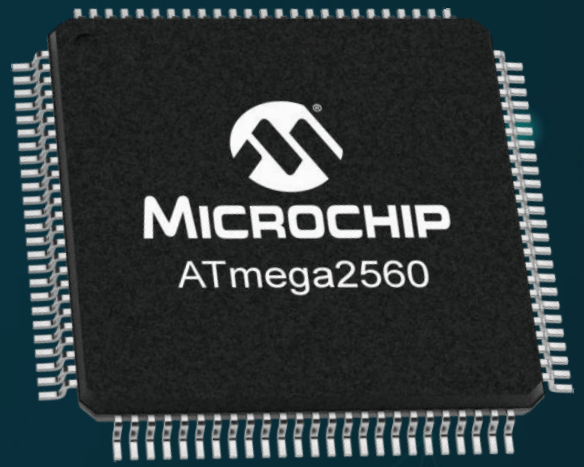
# ARDUINO MEGA 2560




- [] A development board based on Atmega2560 microcontroller as our robot brain.
- [] Has 54 digital input & output pins.
- [] Easy to use
- [] Designed for the projects that require more I/O lines, sketch memory and more RAM.

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# Color detection and robot arm control

# 03

1.TCS3200 color sensor
2.Robot arm design
3.Servo motor control algorithm

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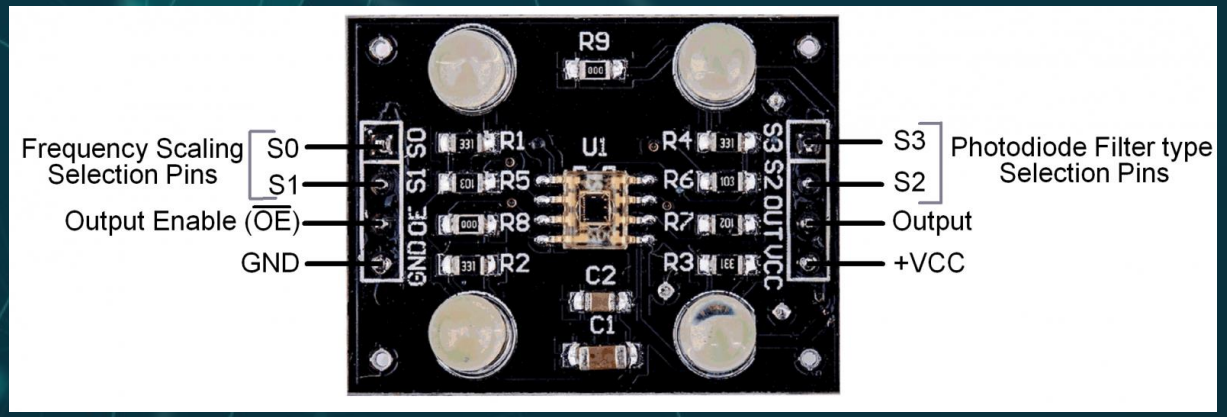
# TCS3200 color sensor

- [] Consists of 4 white LEDs and 8x8 photodiode array. 16 for each red, green, blue and clear filters.
- [] Light reflected from surface falls on filters which produce a current proportional to the frequency of light.
- [] Current-to-frequency converter generates a square wave with frequency proportional to the intensity of received light and it is sent to the Arduino board where color can be identified by the frequency of the signal.
- [] Supply voltage: 5V and Range : ≈1”




**Color filters are powered up according to the inputs given to S2 and S3 control pins**

| S2 | S3 | Photo diode |
|---|---|---|
| L | L | Red |
| L | H | Blue |
| H | L | Clear |
| H | H | green |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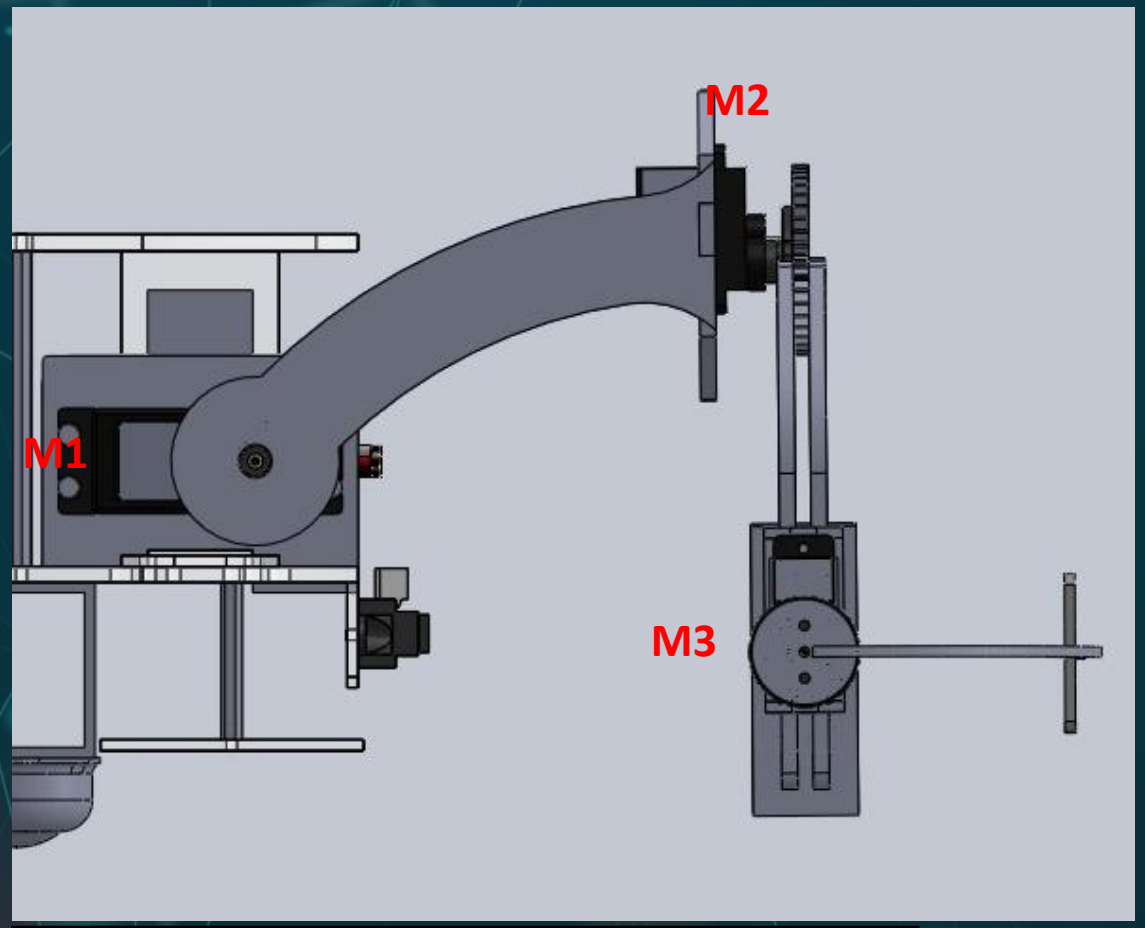
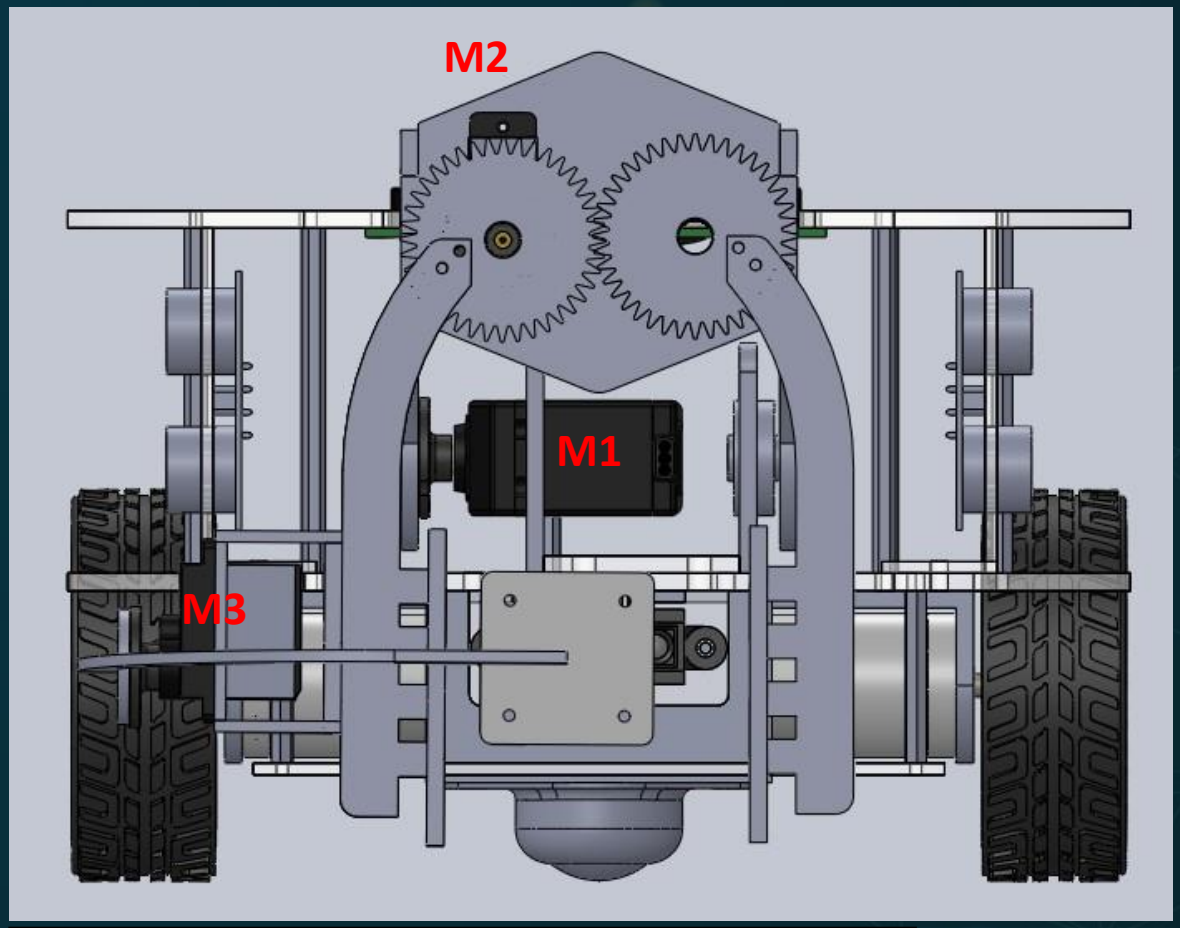
# Robot arm design

**3 Tower pro SG90 micro servo motors are used for M1,M2 and M3.**

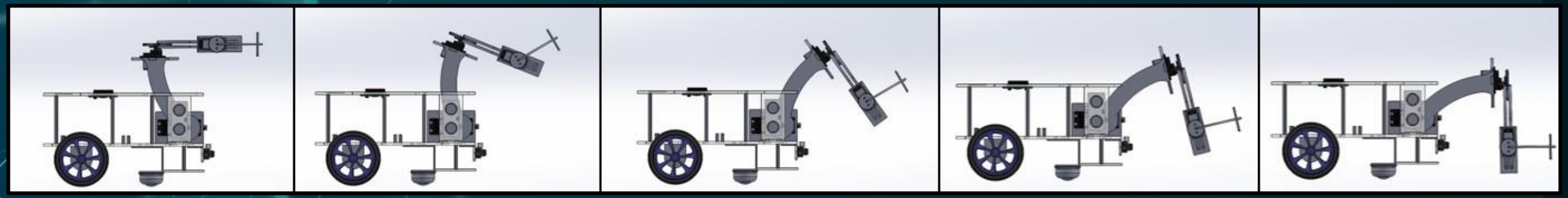



Side elevation

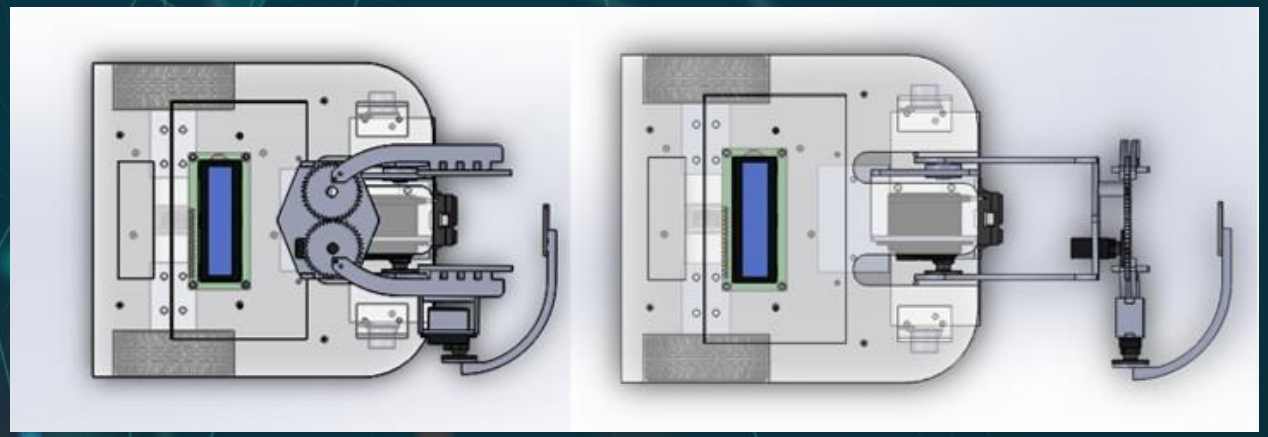



Front elevation

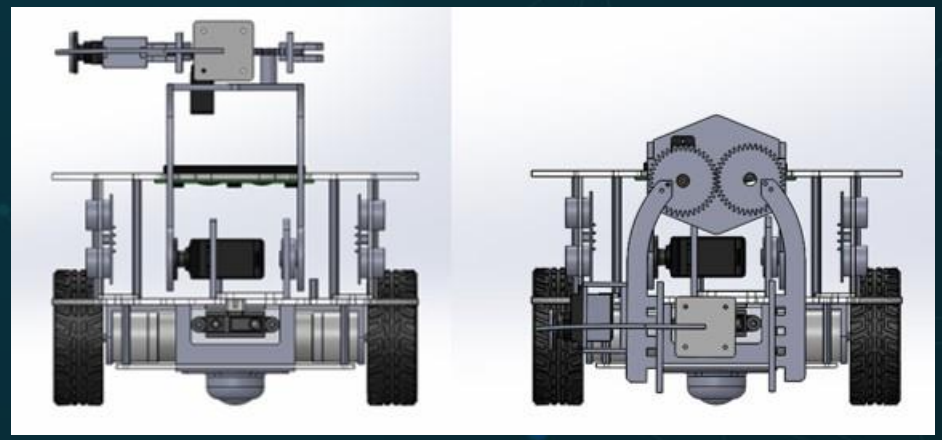
# Robot arm design



Side elevation



Top elevation



Front elevation

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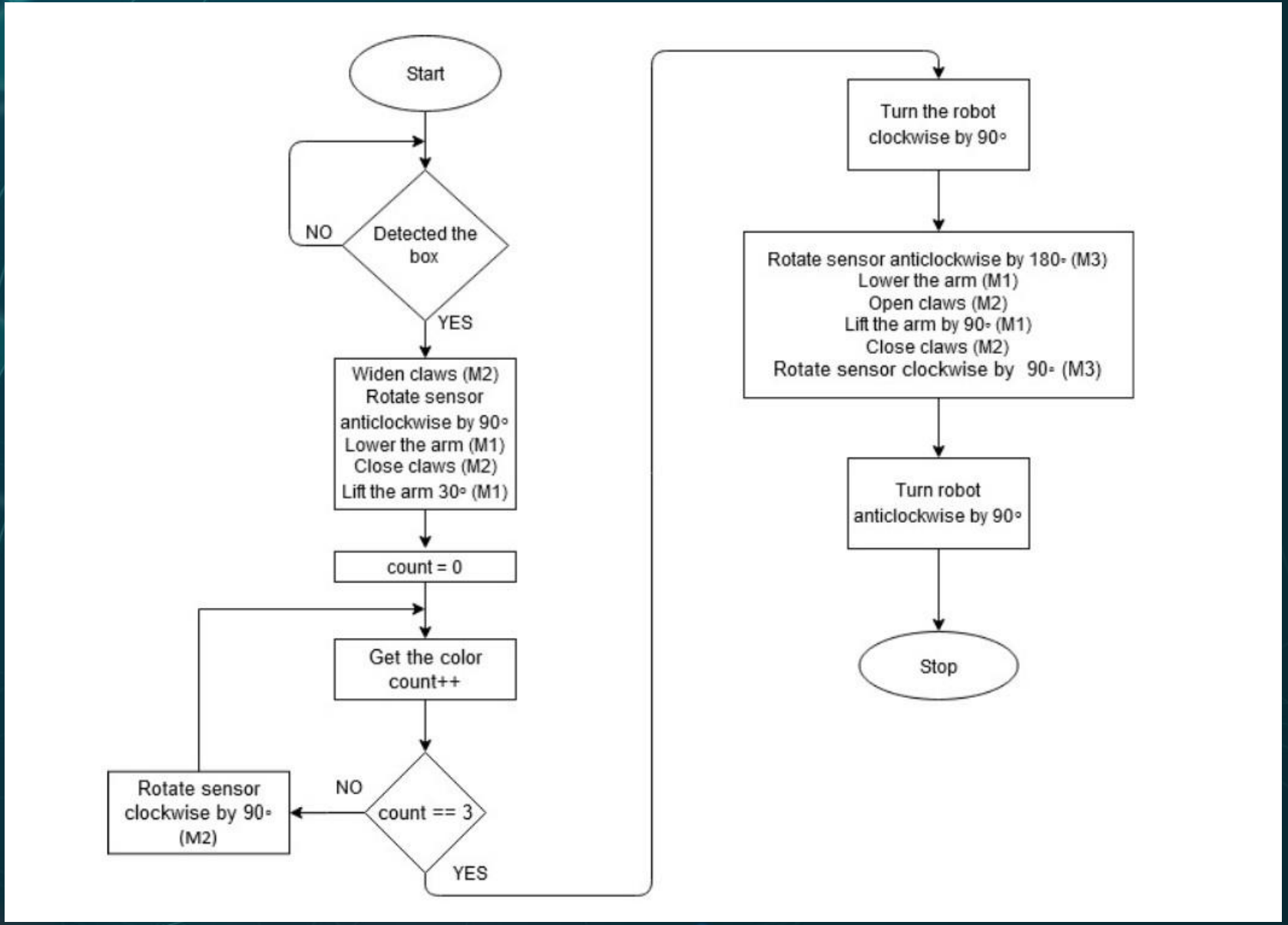
# Servo motor control algorithm



# RAMP AREA

# 04

Strategy for passing ramp Successfully
and robot control

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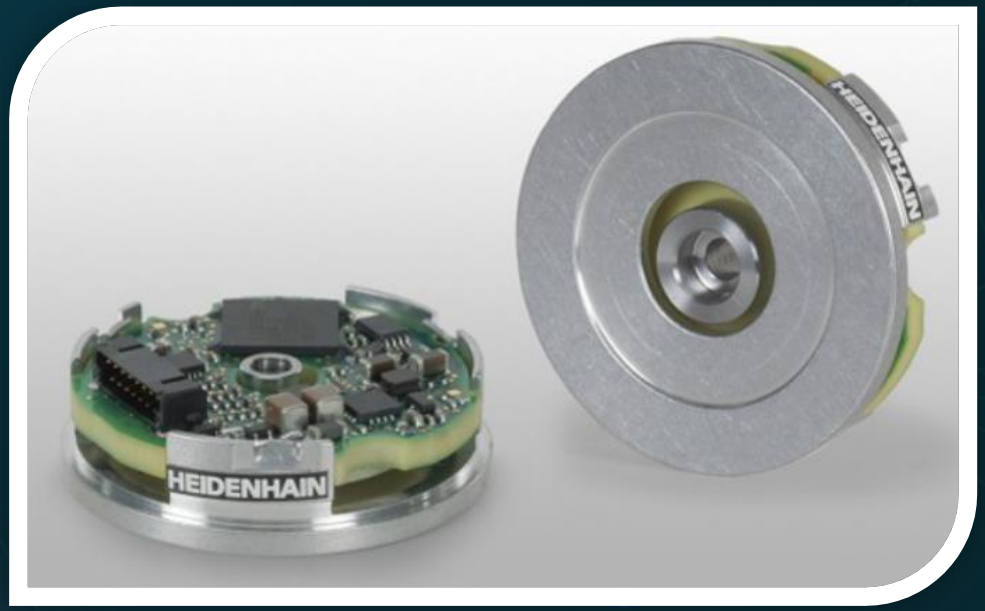
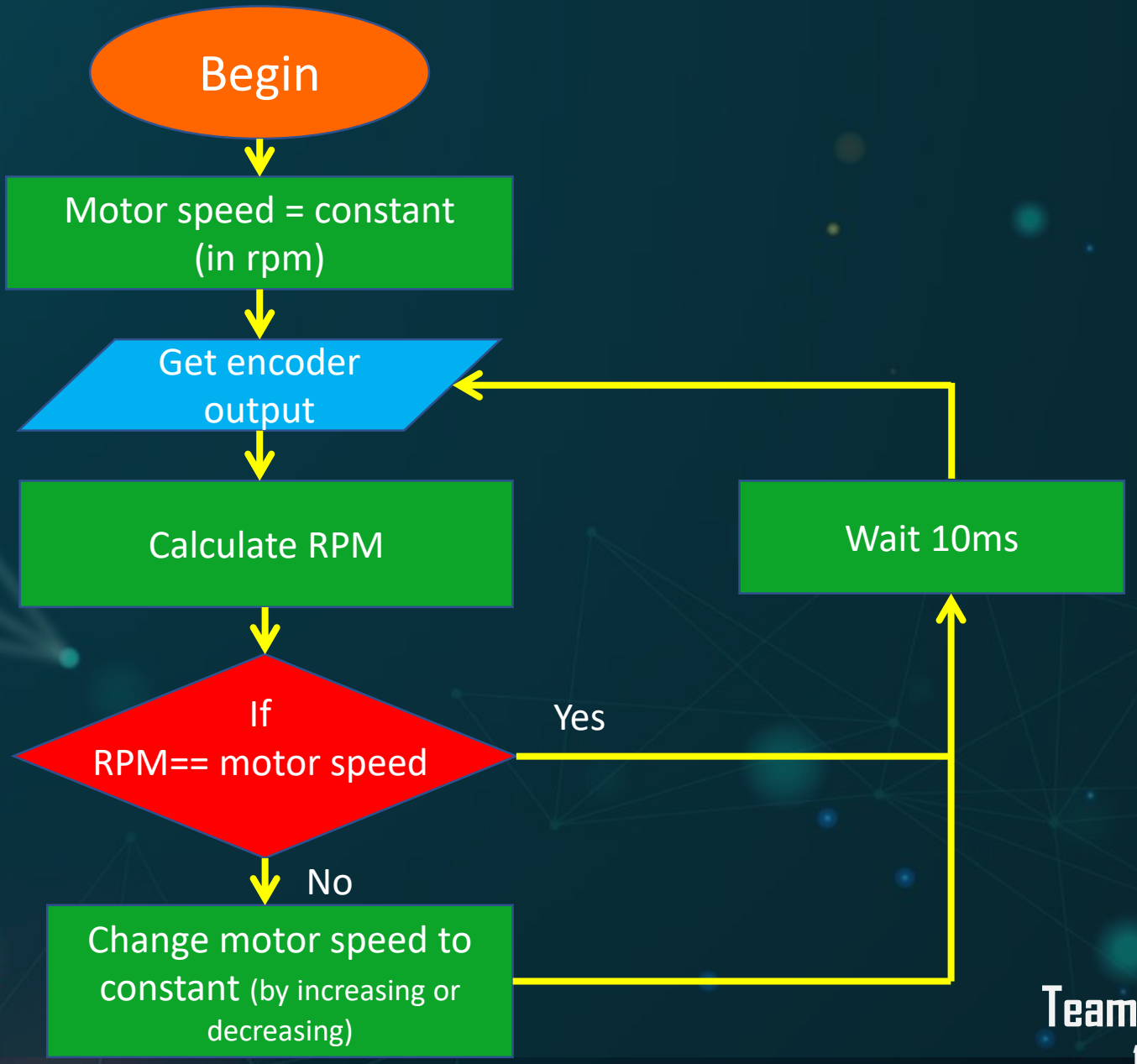
# Description

- [] Ramp Area has three angle segments and one top flat area segment.
- [] we will not use any sensor in robot for the purpose of moving the ramp area.
- [] we hope to move the robot at a constant speed throughout the ramp area.
- [] The encoders are used to measure the  speed of the wheels.
- [] Encoders  maintain a constant speed of the wheels by applying  a motor control loop through the control panel.



# Control loop of the encoders

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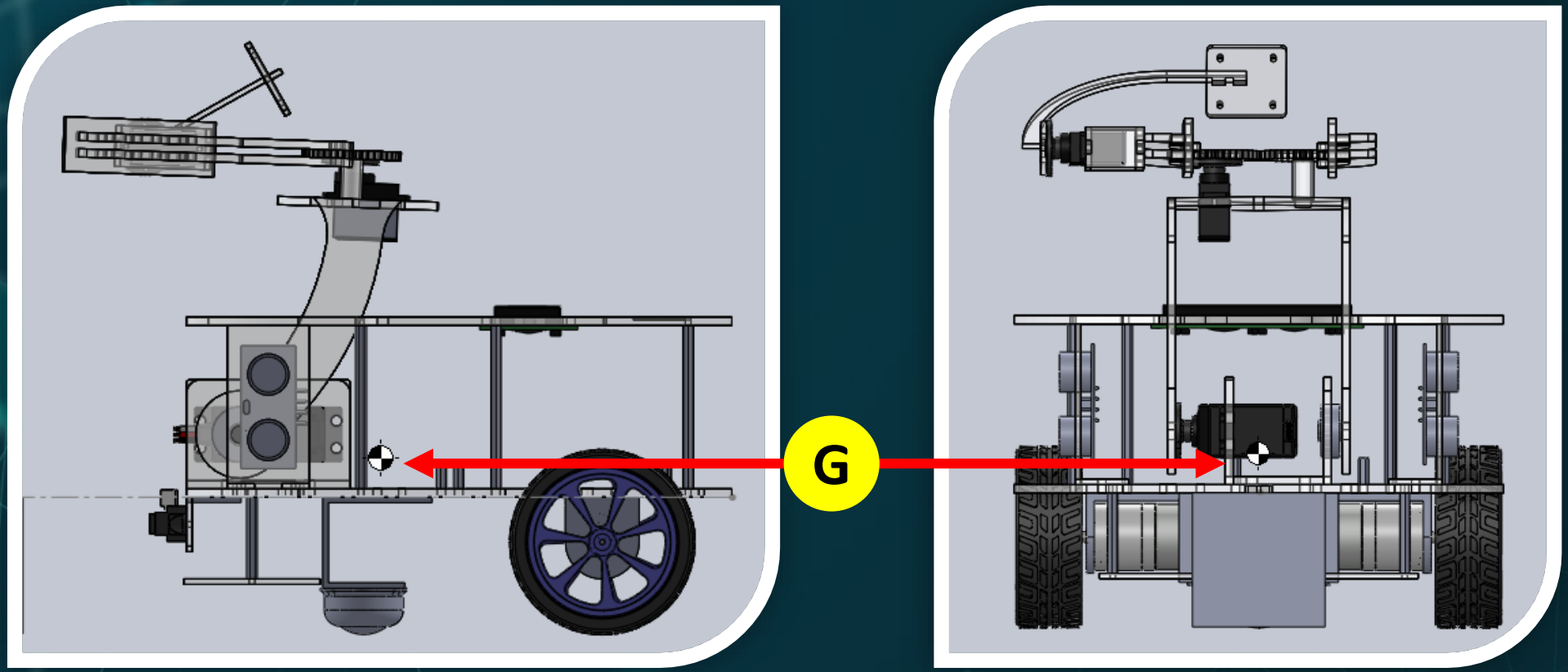
# Center of gravity and stability




- [] The center of gravity of the robot should be close to the base of the robot.
- [] Proper positioning of the robot's battery and other fairly heavy equipment, helps to position the center of gravity near the base.
- [] Since we have not included battery here, when we include it, the center of gravity will considerably move down

# Robot Power

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# The Battery

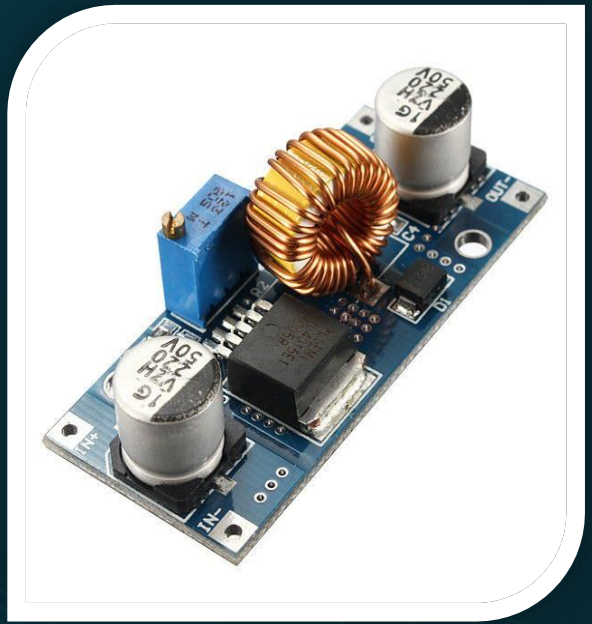
[] We hope to use a single LiPo battery for our mobile robot.

## Specifications

I Size= 132 X 43 X 23 mm
II Battery voltage = 11.1v
III Cell count and arrangement = 3s
IV Battery capacity = 3000mAh
V Discharge rate = 30C continuous and 60 burst

# Reasons for selecting the battery

- [] LiPo batteries are light weight.
- [] High discharge rate
- [] Higher capacity



## Voltage step up and step down

- [] Since we will use a single battery, a 5V buck converter will be used to step down this 11.1v to 5v for microcontroller and sensors.
- [] A 6v buck converter will be used for servo motor.
- [] A 12v boost converter will be used for DC motors.

# 05

# Gates

Identifying the sequence of gates
Methodology for passing them successfully

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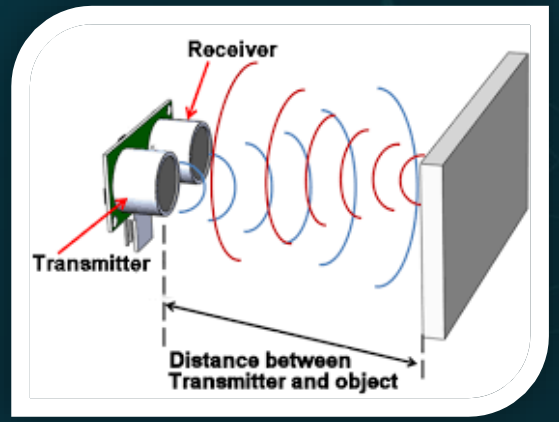
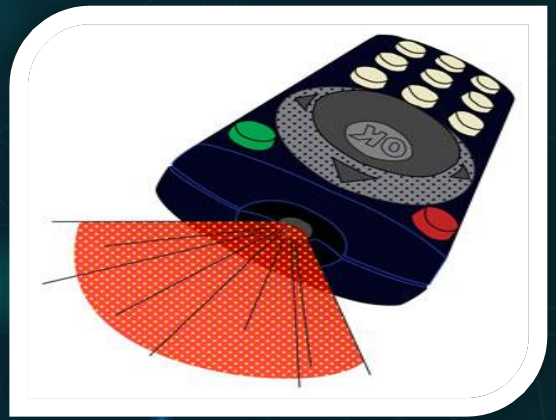
# Sensors & Specifications Phase

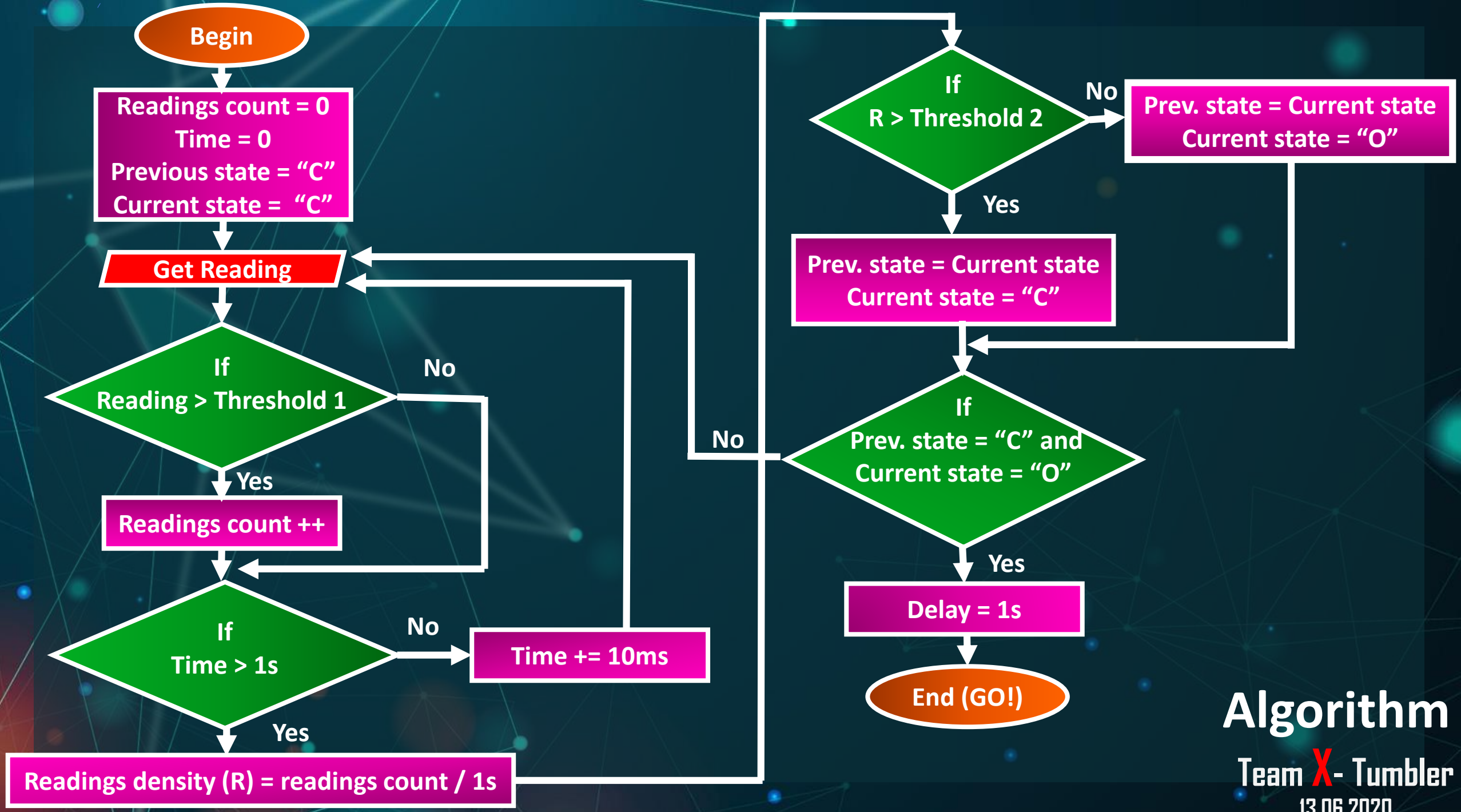
- GP2Y0A21 Sharp IR Sensor

## Why we selected this sensor ?

I. Wave Propagation mode
II. Resolution
III. Range
IV. Accuracy
V. Simplicity




Begin
Readings count = 0
Time = 0
Previous state = “C”
Current state = “C”
Get Reading
If
Reading > Threshold 1
No
Yes
Readings count ++
If
Time > 1s
No
Time += 10ms
Yes
Readings density (R) = readings count / 1s
No
If
R > Threshold 2
No
Prev. state = Current state
Current state = “O”
Yes
Prev. state = Current state
Current state = “C”
If
Prev. state = “C” and
Current state = “O”
Yes
Delay = 1s
End (GO!)
Algorithm
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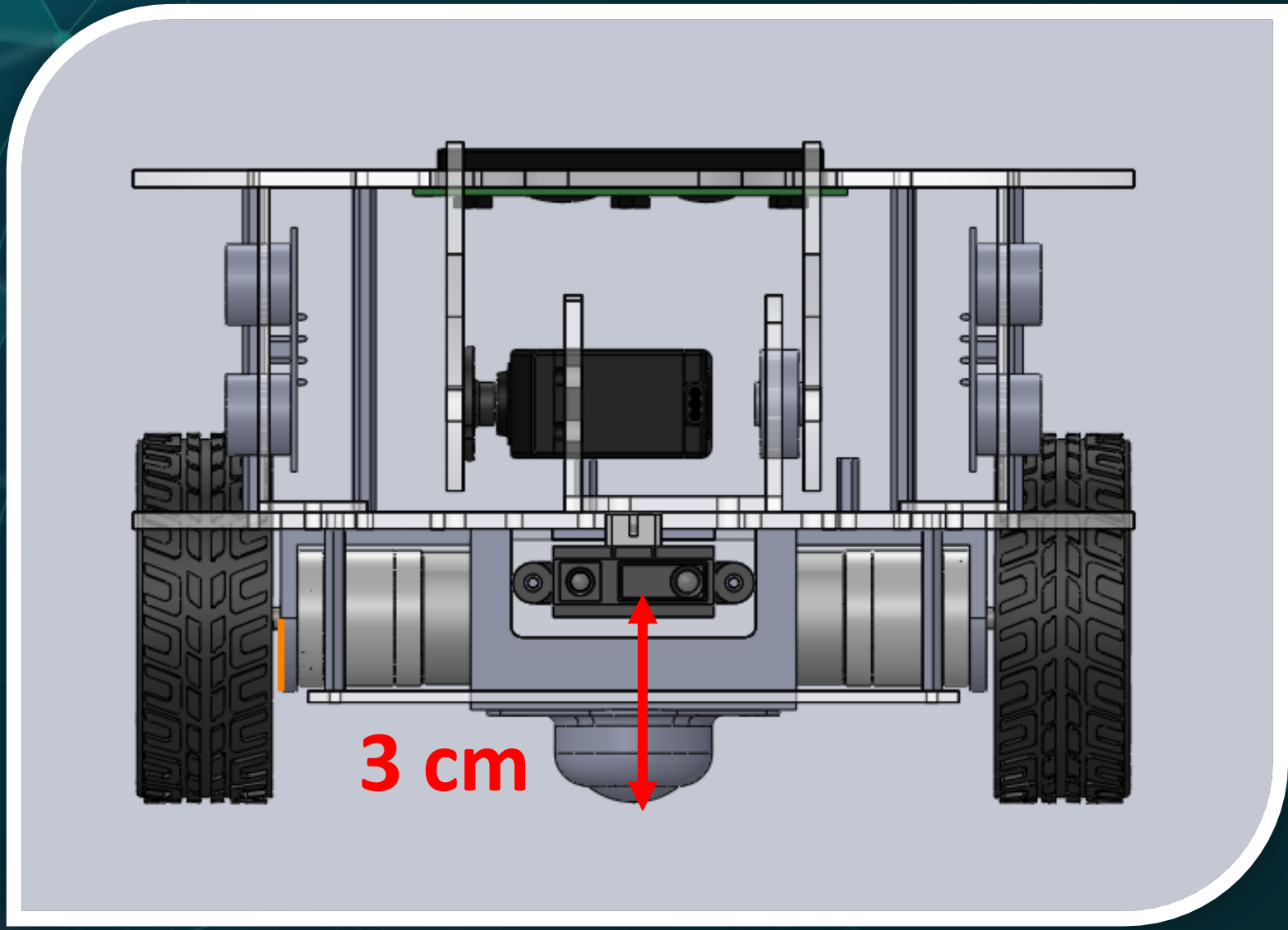
# Hardware Design Phase



# Thank You!

| Task | Person |
|---|---|
| Line Following | T. A. D. S. Tennakoon<br>180639P |
| Wall Following | H. A. D. G. Hettiarachchi<br>180236D |
| Color Detection | D. N. R. Dissanayake<br>180153U |
| Ramp Area | N. G. K. M. Dayasekara<br>180112U |
| Gates | M. M. C. J. Bandara<br>180065C |

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