MAZE-BREAKER

- Group member
    - 敖恺
    - 江柯垚
    - 解炎
    - 姜跃琳
    - 张善
  （排名不分先后）

CATALOGUE

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01 OVERVIEW OF DESIGN

01 OUTLOOKING

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SUMMARY

TAKE A FAST LOOK

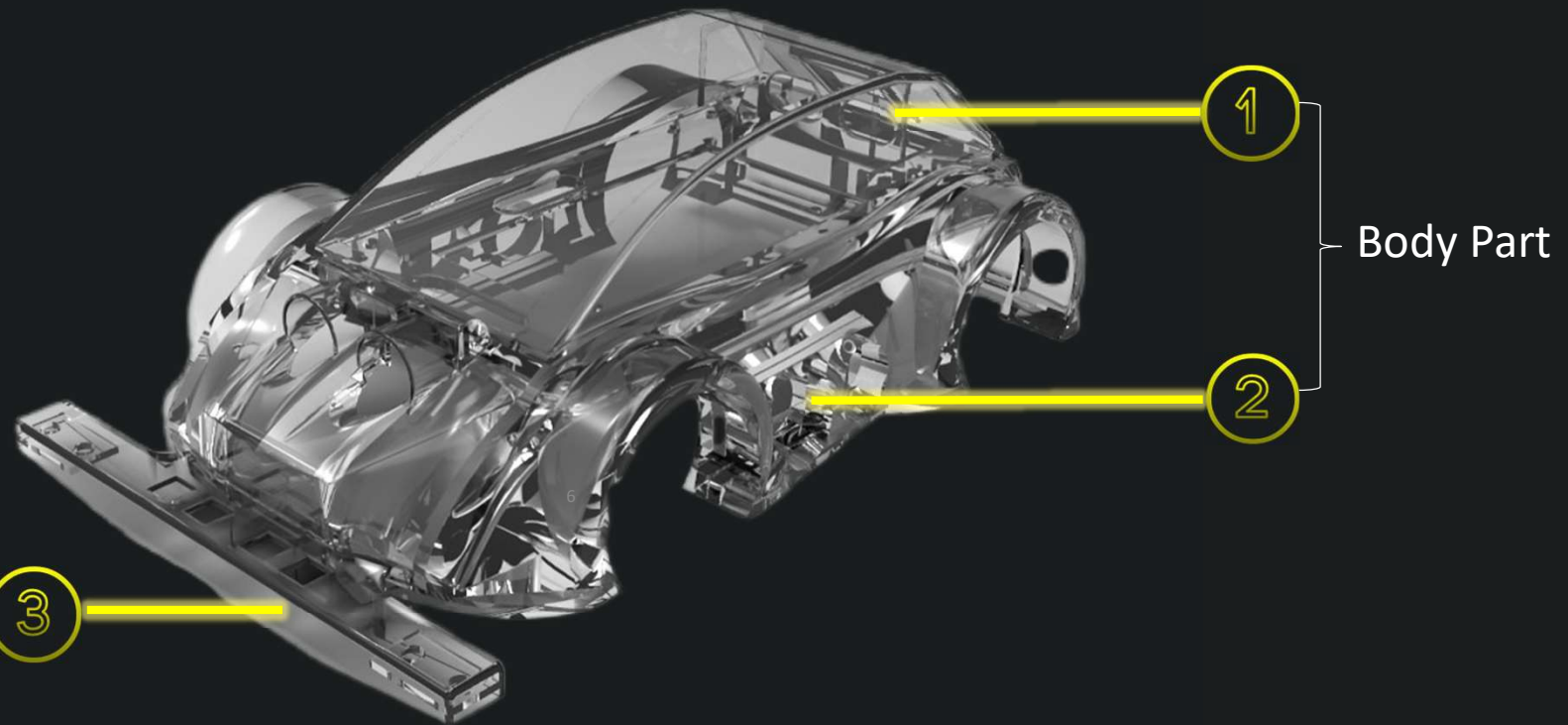01   SHAPE

02   COLOR

03   DECORATIONS

01 SHAPE OUTLOOKING

>SHAPE--3 PARTS

>3 FEATURES

- Hollowing
- Screwless link
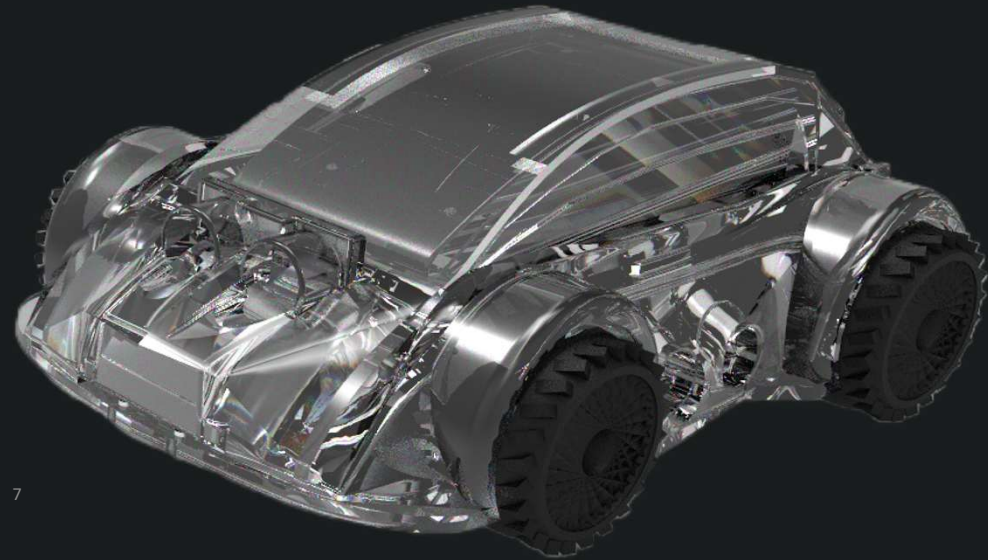- aerodynamic

Body Part

Antenna
-- >infrared
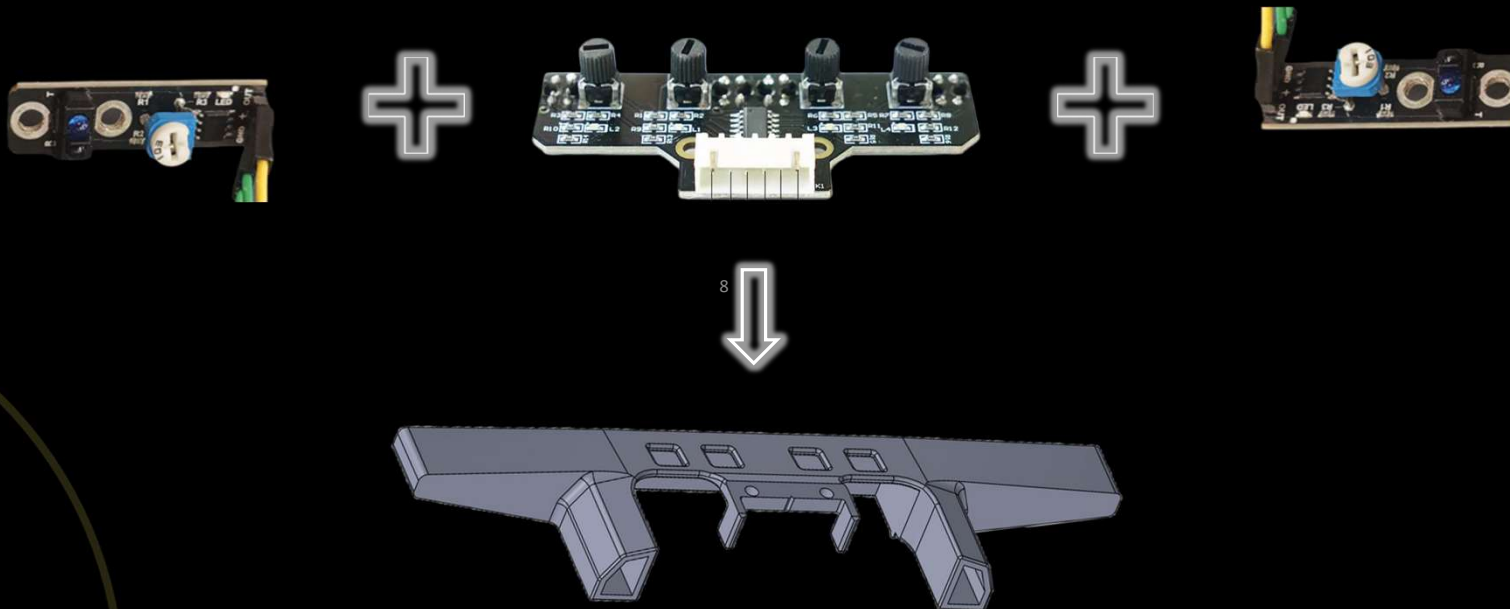tracking module

01 SHAPE BODYPART

- Design idea
  - inspired from sport car
- Function
  - Stable
  - Fast
- Final design
  - Close to the ground
  - Flat body
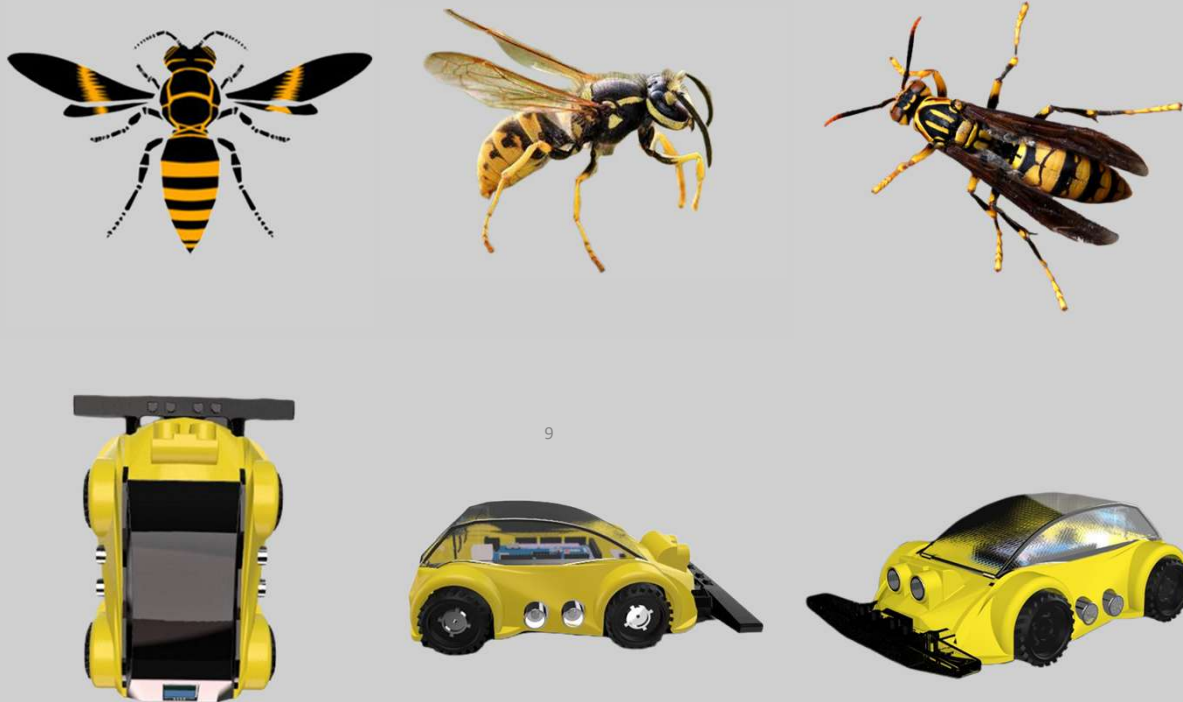 - Aerodynamic/Streamlined
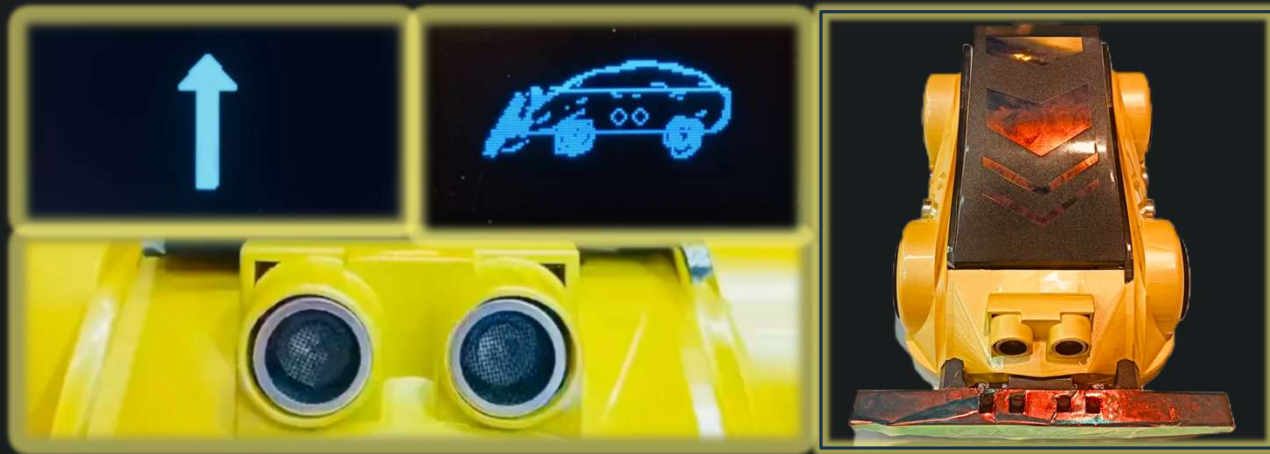
01 SHAPE Antenna

- **Function**
  - Protect the infrared tracking module
  - Expand the scope of exploration

02 COLOR
INSPIRED FROM BEE
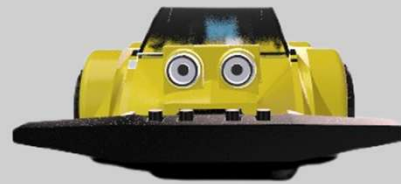
02 DECORATIONS

- LED LIGHT
  - Give out rainbow-color-light when reset successfully.
- SCREEN
  - Show arrows and notices when needed.
  - Print 5 different pixel style car drawn by our groupmate.
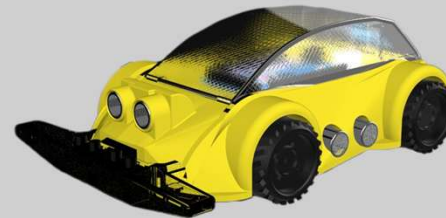- LAYSER-STYLE STICKERS
  - Look more smart.

OVER VEIW OF THE WHOLE PRODUCT
THREE-VIEW GRAPH

OVER VEIW OF THE WHOLE PRODUCT

EXPLODED VIEW

01 OVERVIEW OF DESIGN

02 CHASSIS DESIGN

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1 CHASSIS DESIGN

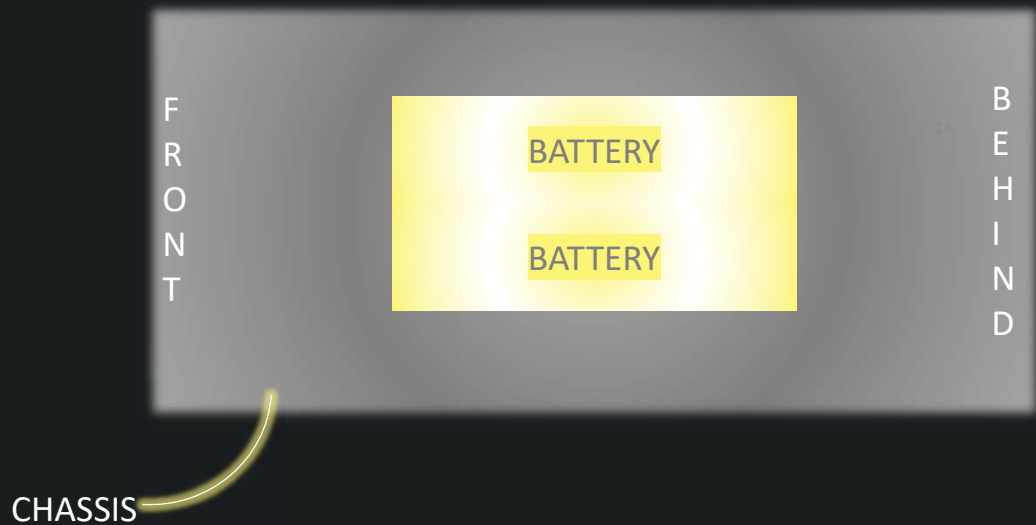**SIDE VIEW**

CHASSIS

BATTERY

OVERLOOK VIEW

F R O N T

BATTERY

BATTERY

B E H I N D

CHASSIS
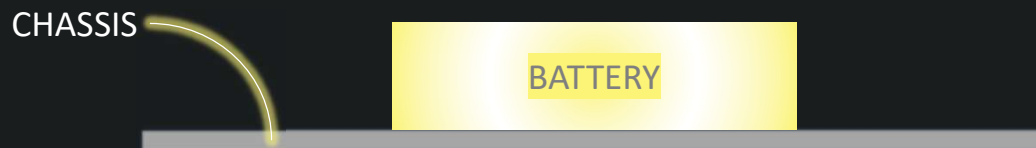
- The long-side of battery case parallel to the long-side of car
  --More space left for the equipment of ultrasonic.

- Leave type-C joggle* on the batter case behind
  --Wires connect easier.

type-C joggle*:Used to charge the battery without removing the batteries.

CHASSIS DESIGN
Boards permutation and combination

- Change
  "YB-MNT03-V1.0+MEGA2560+YB-MNT03V1.0"
  into
  "MEGA2560+MEGA2560 DEVELOPMENT BOARD".

  --Toast-like car swifts into a aerodynamic sport car.
  --Total weight decreased.
  --The position of data transmitting port hidden inside the roof.

YB-MNT03-V1.0*	MEGA2560	YB-MNT03-V1.0

MEGA2560
MEGA2560 DEVELOPMENT BOARD
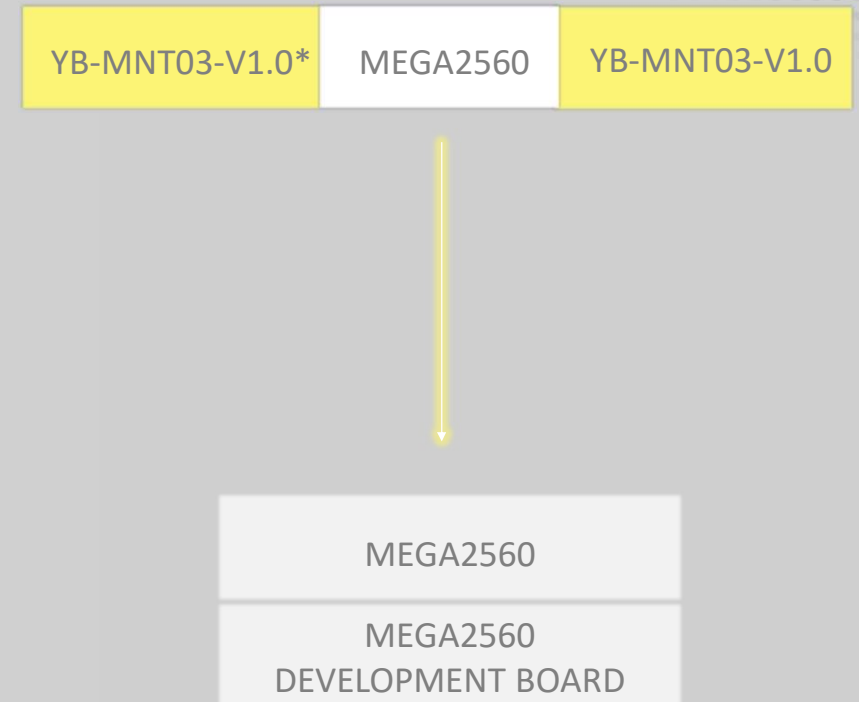
YB-MNT03-V1.0*:Controlling the motor.

CHASSIS DESIGN

Comparing different ways infrared tracking module,
Choose the most suitable one.

- Equipped with one "4 ways" and two "1 way" infrared tracking module on each sides.

- Advantage:

  - The same detecting zone as "8 ways" infrared tracking module.
    --let the car finds its way out quicklier after turning around

  - The same coding algorithm as "6 ways" infrared tracking module.
    --Easier logic than "8 ways" when coding.

- Considered design thinking, "1+4+1"is a balanced layout with the heavy in the middle while the slight on the sides.

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'1+4+1' ways

5 ways

6 ways

8 ways

OVERVIEW OF OUT-OF-MAZE-CODE

OVERAL IDEAS

$\rightarrow$

1 EXPLORE THE WAY OUT

Abstract the zero-one-matrix from the trail.
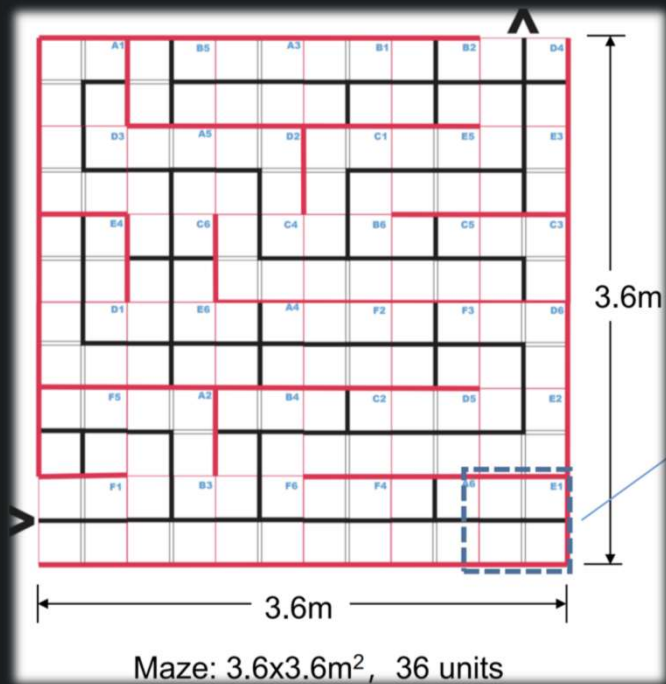
2 REMAP THE ZERO-ONE-MATRIX

Delete dead ends.

3 GET CORNER'S COORDINATE

Select corner by traversal.

4 WALK OUT WITHOUT DEAD ENDS

Use selected corners when needed.

1 EXPLORE THE WAY OUT

ABRACT

MAZE MAP

13*13MATRIX

2 REMAP THE
ZERO-ONE-MATRIX

1	0	0	0	0	0	0	0	0	0	0	1	0
2	0	1	0	0	0	0	0	0	0	0	1	0
3	0	1	0	0	0	0	0	0	0	0	1	0
4	0	1	1	1	1	0	1	1	1	1	1	0
5	0	0	0	1	0	1	0	1	0	0	0	0
6	0	1	0	1	0	1	1	0	0	0	0	0
7	0	1	0	1	0	0	0	0	0	0	0	0
8	0	1	1	1	1	1	1	1	1	1	1	0
9	0	0	0	0	0	0	0	0	0	0	1	0
10	0	1	1	1	0	1	1	1	1	1	1	0
11	0	0	0	1	0	1	0	0	0	0	0	0
12	1	1	1	1	1	1	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0

REMAP

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```
00000000000010
00000000000010
00000000000010
00011101111110
00010101000000
00010111000000
00010000000000
00011111111110
00000000000010
00000111111110
00000010000000
11111100000000
00000000000000
```

03 GET CORNER'S COORDINATE
TIME CONSUMPTION OF REMAPPING

- Create 4 "maps" for testing.
- Use the number of useless points to evaluate the "game" level.

		Test 1	Test 2(sample)	Test 3	Test 4
Useless points' level		5	1.2	1	1.7
Remapping time/ (milliseconds)	1	29	23	27	22
	2	27	20	25	25
	3	29	24	24	25
	AVG	28.33333333	22.33333333	25.33333333	24

CONCLUSION: THE MORE USELESS POINTS THERE ARE, THE MORE TIME IT CAUSE

03 GET CORNER'S COORDINATE

METHOD OF RECOGNIZING CORNERS.

- Enum all the situations of the corners.
- Compare the map(matrix) with these 4 kinds of turns.
- Get its cooperate and relative direction[22]

```
1 0    0 1    1 1    1 1
1 1    1 1    1 0    0 1
```

03 GET CORNER'S COORDINATE

• Use the number of useless points to evaluate the "game" level.

		Test 1(sample)	Test 2(sample)	Test 3	Test 4
Num Of useless points		1	11	13	77
Getting corner points' time/(nanoseconds)	2	17100	33600	28800	24700
	3	17200	23100	32700	25200
	AVG	16533.33333	28100	32333.33333	26366.66667

CONCLUSION: THE MORE USELESS POINTS THERE ARE, THE MORE TIME IT CAUSE

03 WALK OUT WITHOUT DEAD ENDS

Use selected corners when needed.

```
11,5
9,5
9,11
7,11
7,3
3,3
3,5
5,5
5,7
3,7
3,11
```

OUTPUT

- When arrived turning points, compared its cooperate with the array's elements.
- Get its turning direction, and invocation methods of running the car.

03 OUR HIGH-LIGHTS ON
Electric control

01 PID

INCREMENT PID
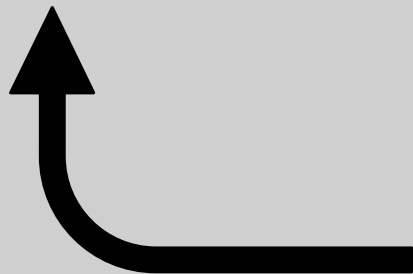
OVERAL VIEW

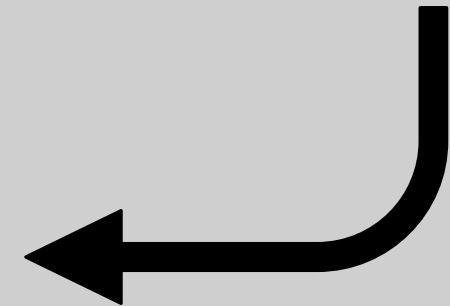Control the duty cycle of the PWM wave

VS

Set the target rotational speed → Calculate the PWM duty cycle that should be set → Input the duty cycle to the motor

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The actual rotational speed is measured by means of an encoder

INCREMENT PID

MATHEMATIC INTRODUCTION

Position-based

$$u(k) = e(k) + \Sigma e(i) + \frac{de(t)}{dt}$$

Differentiate both sides of the equation

Increment

$$\Delta u(k) = \frac{de(t)}{dt} + e(k) + \frac{d^2 e(t)}{dt^2}$$
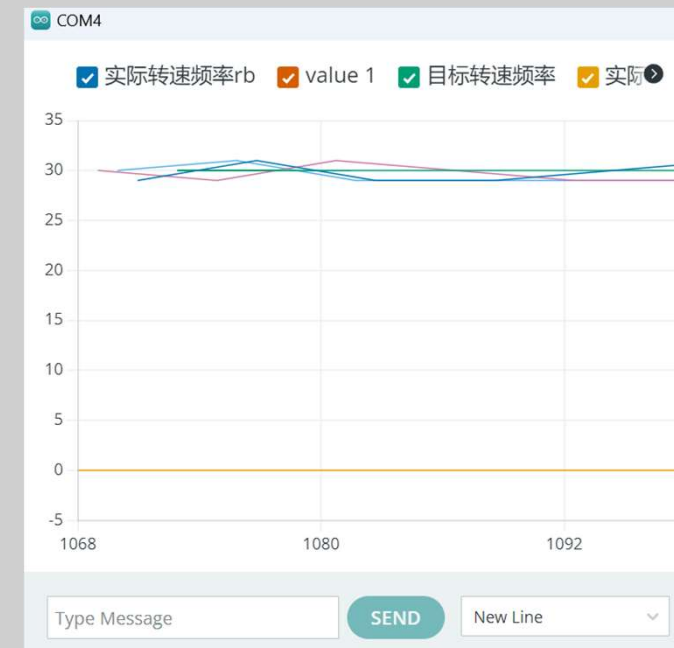
INCREMENT PID

COMPARISON

PWM wave
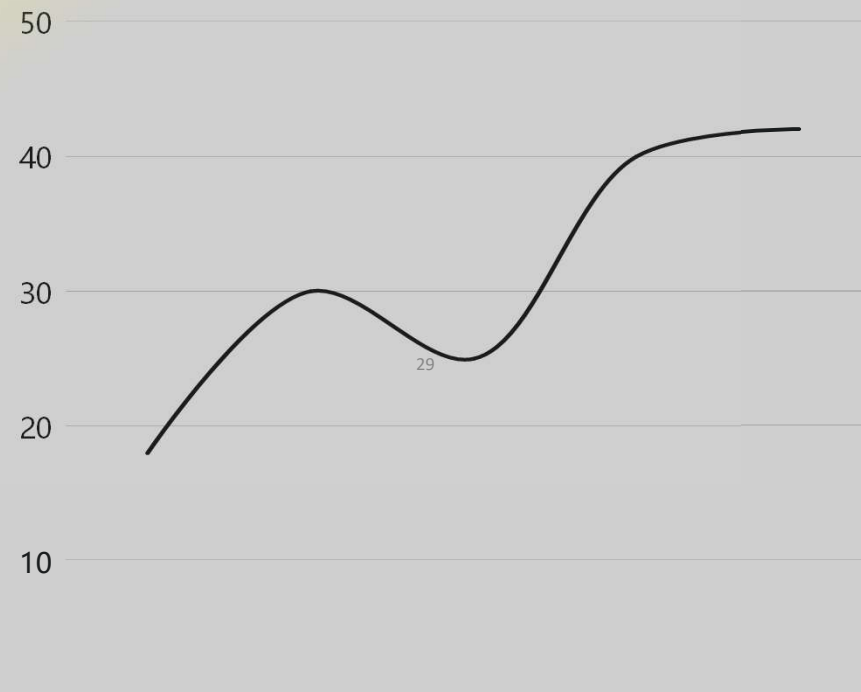

Integral coefficient
Proportional coefficient

Integral coefficient
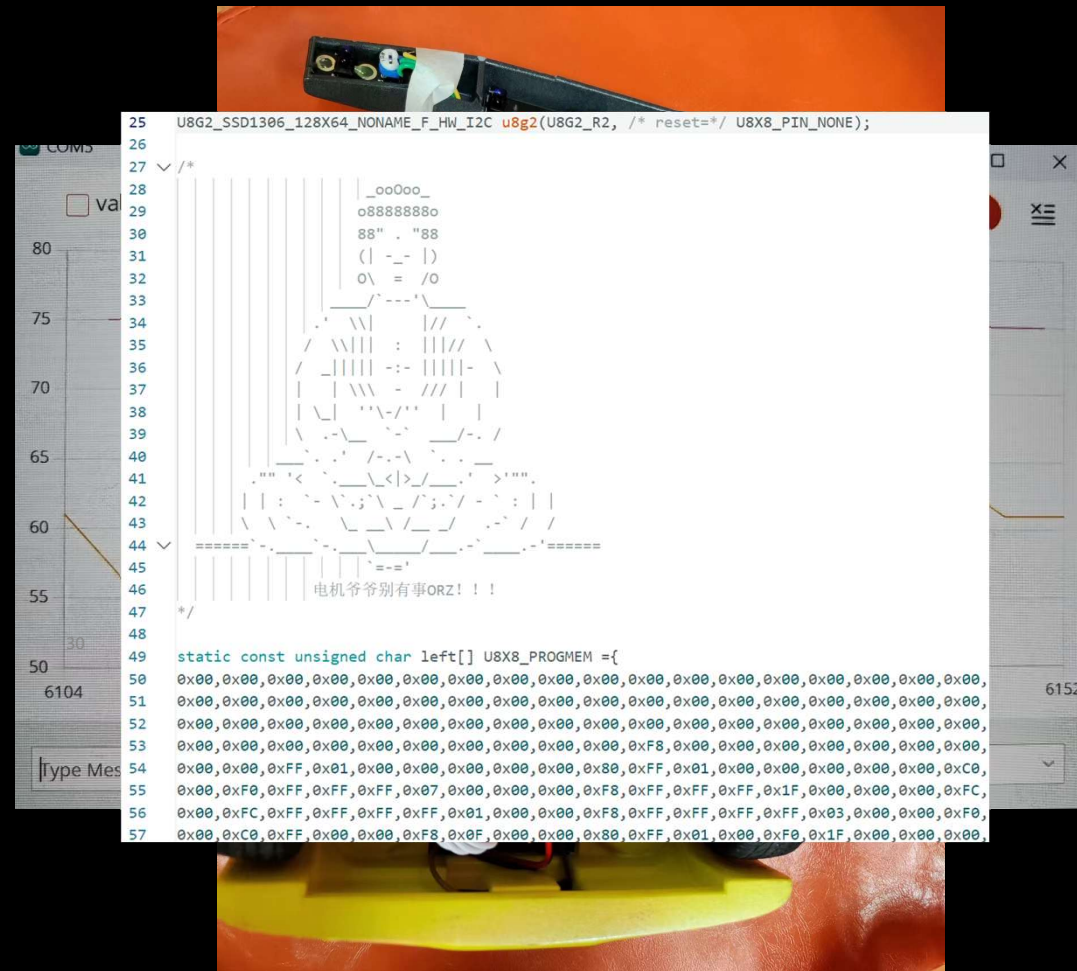Derivative coefficient
Proportional coefficient

INCREMENT PID

QUESTION

Getting better and better?

PID

- Code to control motor

- Hardware

- New function

Electric control

- The infrared tracking module

  - Out –loop control

- PID

 - Inner-loop control

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03 OUR HIGH-LIGHTS ON
Electric control

02 Gyroscope sensor MPU6050

03 GROSCOPE SENSOR MPU6050

- A gyroscope is an inertial measurement device used to sense and maintain direction
- Feature
- Functions performed this time:
- The rotation Angle is obtained by integrating twice to ensure accurate steering
- Types of data the gyroscope can obtain:
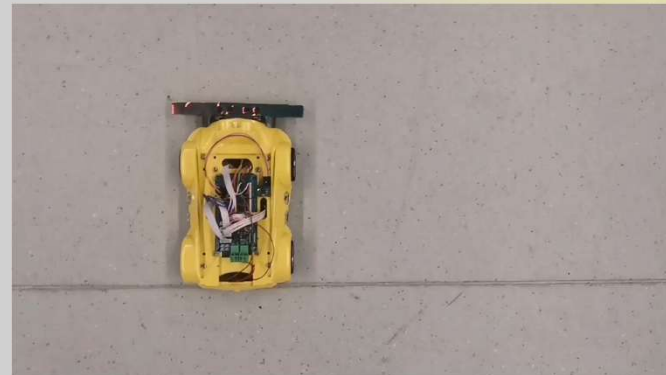 - triaxial acceleration
  - triaxial angular acceleration
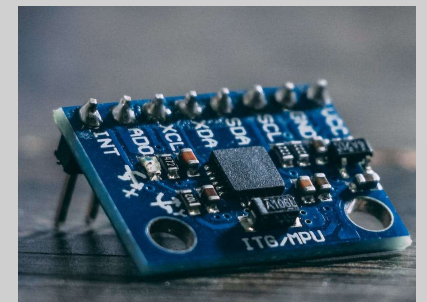
03 GROSCOPE SENSOR MPU6050

WHY WE USE IT?

Without MPU6050

With MPU6050

Control the wheels to turn better.

03 GROSCOPE SENSOR MPU6050

Get gyro sensor Z-axis data

- Derivatives it to get the rotation Angle YAW about the z axis

- Connect the sub-board UNO board to perform mathematical processing on YAW value and convert it to 0-255 non-negative number for easy transmission

- The MEGA motherboard uses serial communication to obtain Angle data from the UNO when the car needs to turn
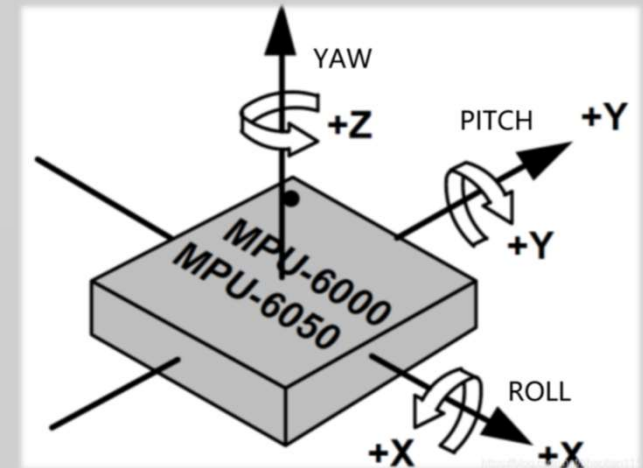
Control the wheels to turn better.

https://blog.csdn.net/lihaotian111/article/details/117307644
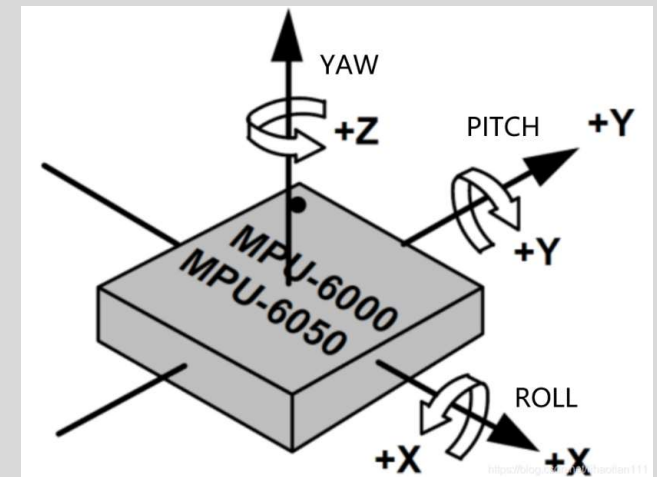
03 GROSCOPE SENSOR MPU6050

COMPARISON ON EQUIPPING MPU6050 OR NOT

- Before:
  - speed cannot be accelerated by using PID.
    - The wheel slipping
- After:
  - Be able to turn 90 degrees or 180 degrees, improve stability and controllability
  - improve car speed
- Turning without run forward.

CATALOGUE

THANKS FOR LISTENING