# Lesson 5 Move Forward, Backward, Left and Right

1. Working Principle

According to characteristic of mecanum wheel, only when all wheels rotate forward, car goes forward. When all wheels rotate in reverse, car goes backward. When A wheels rotate in reverse and B wheels rotate forward, car moves left. When B wheels rotate in reverse and A wheels rotate forward, car moves right. The analysis of force is as pictured.
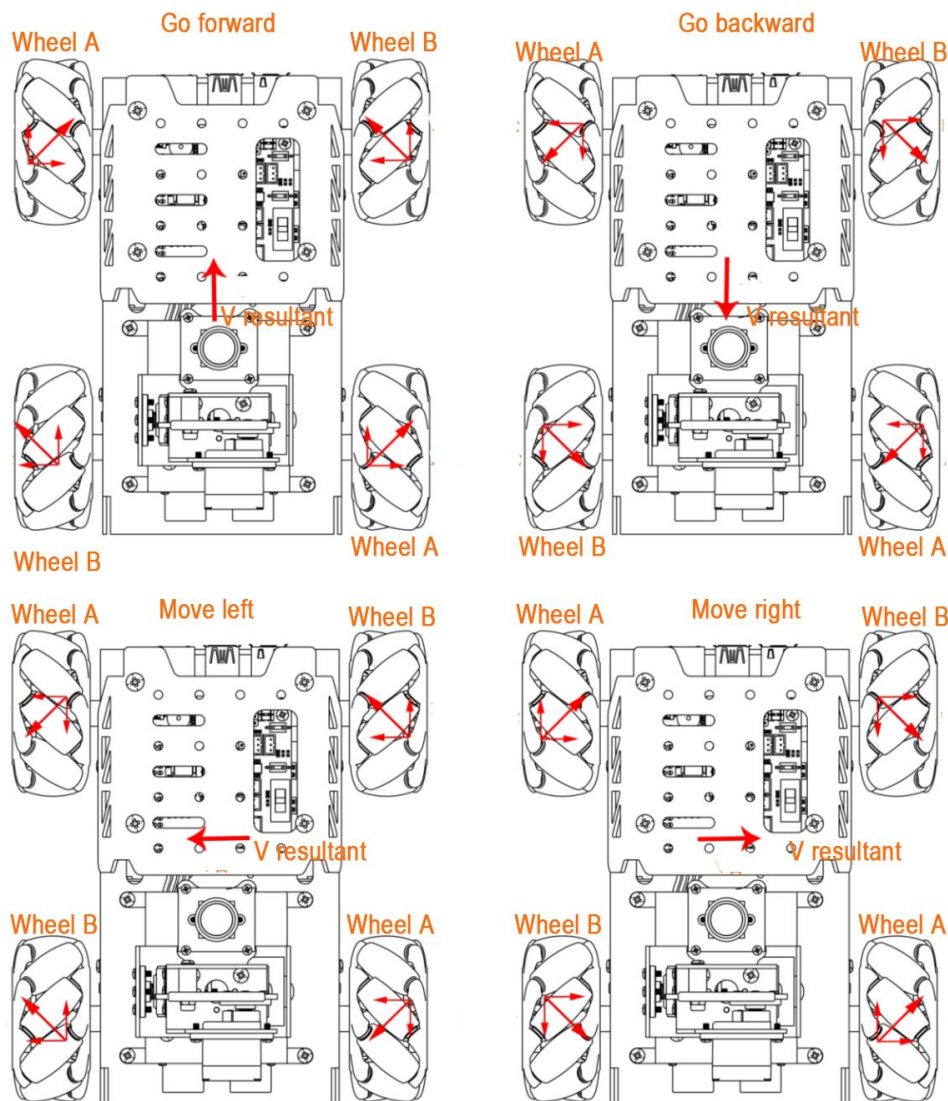
Based on physical kinematics, when forces are equal and opposite to each other, they cancel each other out. Suppose wheel A and wheel B rotates at the same speed, a right force decomposed by wheel A and a left force decomposed by wheel B will cancel each other out, and then work together to make the car go forward. Based on Newton's second law (F=ma), if acceleration is forward, the final resultant force is also forward.
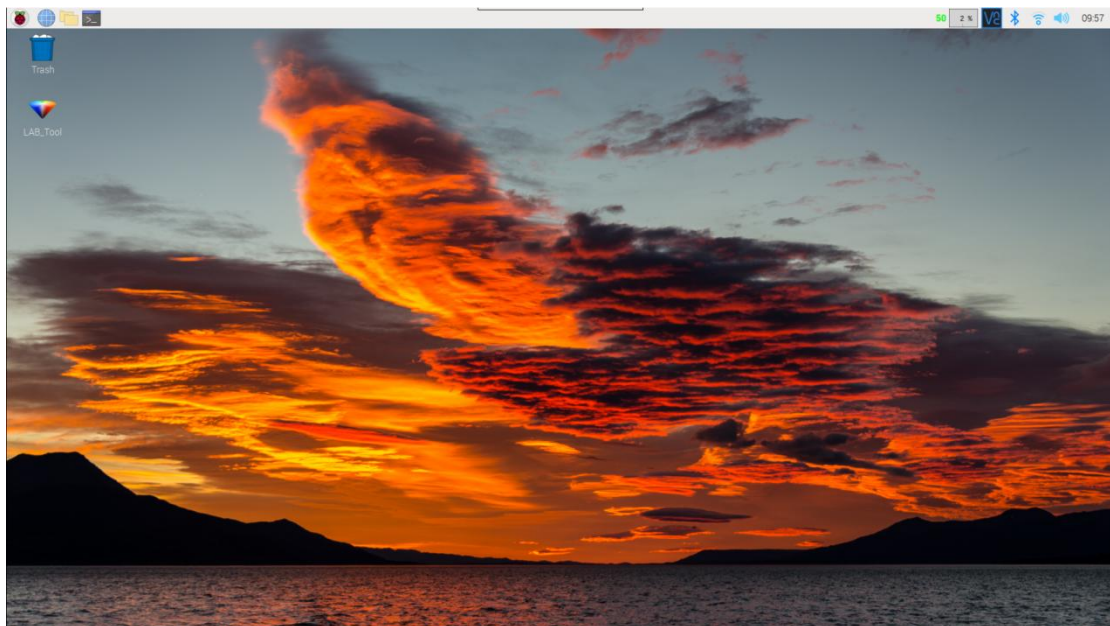
2. Operation Steps

The input command should be case sensitive. Keywords can be complemented by "**Tab**" key.

1) Start TurboPi. Connect to robot system desktop through VNC. For how to operate, refer to the file in "**3. Assembly and Debugging\Lesson 3 Remote Desktop Installation and Connection**".

2) Click [>_] or press "**Ctrl+Alt+T"** to enter the LX terminal.

3) Input command "**cd TurboPi/MecanumControl/**" and press Enter to enter the catalog where game programs are stored.

4) Input command "**sudo python3 Car_Move_Demo.py**" and press Enter to start the game.

5) If you need to stop this game, you can press "**Ctrl+C**". If the game cannot be closed, you can try again.

3. Program Outcome

After game starts, TurboPi goes forward, moves right, goes backward and moves left in sequence.
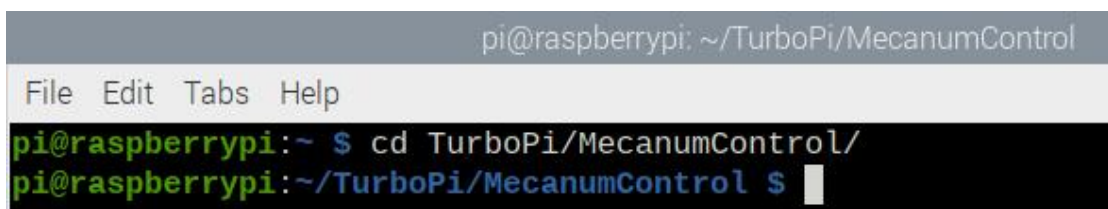
4. Function Extension

The default speed of going forward is 50. You can change the speed in the program. For example, 90.
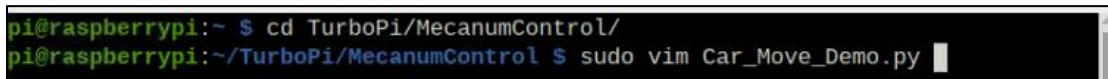
1) Click or press "**Ctrl+Alt+T**" to open LX terminal.

2) Input command "**cd TurboPi/MecanumControl/**" and press Enter to enter the directory where game programs are stored.

3) Input command "**sudo vim Car_Move_Demo.py**" and press Enter to open program file.

4) Press "I" key to modify the content as pictured. When "INSERT" appears, you can start editing.

5)   In "**set_velocity**" function, the first parameter refers to motor speed.

Change it to 90. After modification, press Esc, input ":wq", and then press

Enter to save and close the program file.

```
40 if __name__ == '__main__':
41     while start:
42         chassis.set_velocity(50,90,0) # 控制机器人移动函数,线速度50(0~100),
   方向角90(0~360),偏航角速度0(-2~2) Movement control function. The linear vel
   ocity is 50 (0~100). The direcion angle is 180 (0-350). The jaw velocity is
   0.3 (-2~2).
43         time.sleep(1)
44         chassis.set_velocity(50,0,0)
45         time.sleep(1)
46         chassis.set_velocity(50,270,0)
47         time.sleep(1)
48         chassis.set_velocity(90,180,0)
49         time.sleep(1)
50     chassis.set_velocity(0,0,0)   # 关闭所有电机 Turn off all motors
51     print('Closed')
52
53

:wq
```

Note: adjust the speed from -100 to 100. When the value is positive number, motors

rotate forward. When it is negative number, motors rotate backward. Since

movement direction of car changes when value is set as negative, it is

recommended to adjust the value within 0~100.

5. Program Analysis

The program is stored in

/home/pi/TurboPi/MecanumControl/Car_Move_Demo.py

```
40 if __name__ == '__main__':
41     while start:
42         chassis.set_velocity(50,90,0) # 控制机器人移动函数,线速度50(0~100),方向角90(0~360),偏航角速度0(-2~2)
43         time.sleep(1)
44         chassis.set_velocity(50,0,0)
45         time.sleep(1)
46         chassis.set_velocity(50,270,0)
47         time.sleep(1)
48         chassis.set_velocity(50,180,0)
49         time.sleep(1)
50     chassis.set_velocity(0,0,0)   # 关闭所有电机 Turn off all motors
51     print('Closed')
52
```

set_velocity function is mainly used to control motors. It has three parameters. Take "**chassis.set_velocity(50,90,0)**" as example.

1)   The first parameter "**50**" is motor linear velocity ranging from -100 to 100 mm/s. When the value is negative number, motor rotates in reverse.

2)   The second parameter "**90**" is movement direction of car. It ranges from 0 to 360 degree. 90 degrees corresponds to front, 270 degree corresponds to back, 0 degree corresponds to right and 180 degree corresponds to left.

3)   The third parameter "**0**" is yaw rate ranging from -2.0 to 2.0. 0 means that there is no angular velocity. When the value is positive number, car rotates clockwise. When it is negative number, car rotates counterclockwise. The greater the absolute value, the faster the car moves.