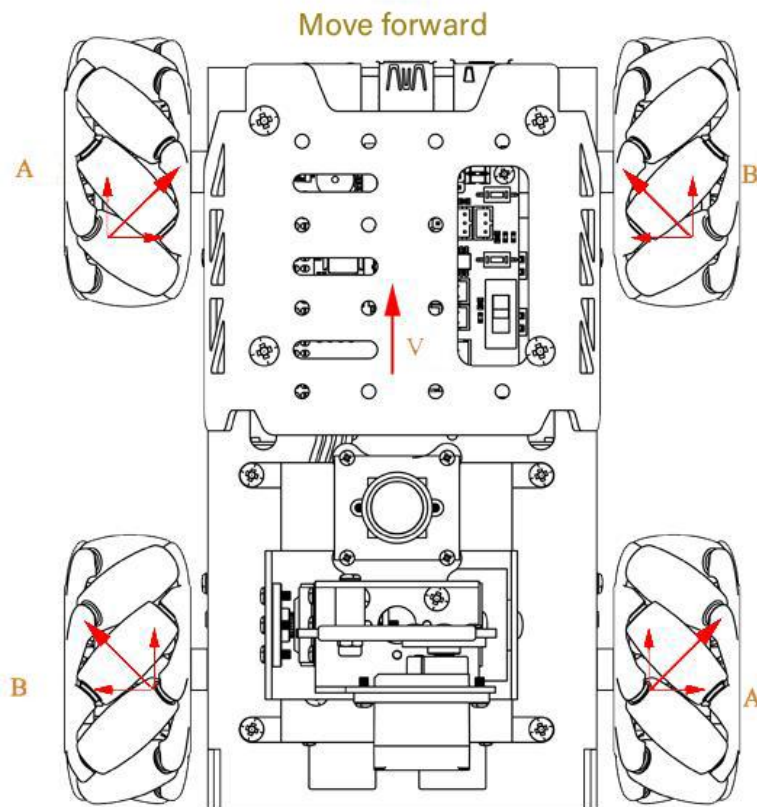# Lesson 2 Move Forward

1. Working Principle

According to the characteristic of mecanum wheel, when the car moves forward, the four wheels must rotate clockwise. The force analysis is shown in the following figure:

According to physical kinematics, when forces are equal and opposite to each other, they will counteract each other. Any force can be decomposed into two perpendicular vectors. Suppose the speed of 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 counteract each other, which the direction of resultant velocity is forward.
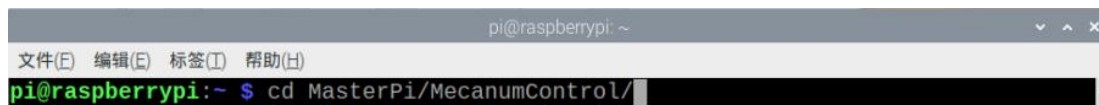
Based on Newton's second law (F=ma), if the direction of acceleration is forward, the final resultant force is also forward.
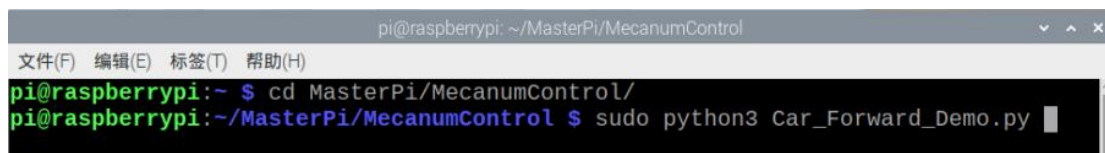
2. Operation Steps

ℹ The entered command should be case sensitive and "Tab" key can be used to fill in keyword.

1) Click [>_] to enter the LX terminal.

2) Enter "cd MasterPi/MecanumControl/" command to come to the directory of game programmings.

3) Enter "sudo python3 Car_Forward_Demo.py" command and press "Enter" to start game.

4) If want to exit the game, you can press "Ctrl+C". If fail to exit, please try multiple times.

3. Project Outcome

After starting the game, MasterPi will move forward.

4. Function Extension

The default movement speed is 50. In this section, the car speed will be modified to 90. Please refer to the following specific steps:

1) Click [>_] to enter LX terminal.

2) Enter "**cd MasterPi/MecanumControl/**" command and press "Enter" to come to the directory of game programmings.

3) Enter "sudo vim Car_Forward_Demo.py" command and press "Enter" to open program file.

4) Find the code to be modified and press "i" to enter the editing mode.

5) In "set_velocity" function, the first parameter represents the motor speed and we modify it to 90. After modifying, press "Esc" and enter ":wq", and then press "Enter" to save ans exit.

Note: The adjustable range of speed is "-100~100". When the value is positive, the motor will rotate clockwise. When the value is negative, the motor will rotate counterclockwise. When the positive value is modified to negative value, it may change the movement direction. Therefore, it is recommended to modify the value between 0 and 100.

5. Program Analysis

The source code of the program is located in: /home/pi/MasterPi/MecanumControl/Car_Forward_Demo.py

5.1 Import Parameter Module

Import module	Function
import sys	Importing the Python sys module is used for getting access to the relevant function and variables
import time	Importing the Python time module is used for time-related functionalities, such as delay operations.
import signal	The receiving and processing of the signal
HiwonderSDK.mecanum	The control module related to mecanum wheel chassis

5.2 Program Logic and Corresponding Code Analysis

The diagram of program logic refers to the below figure.
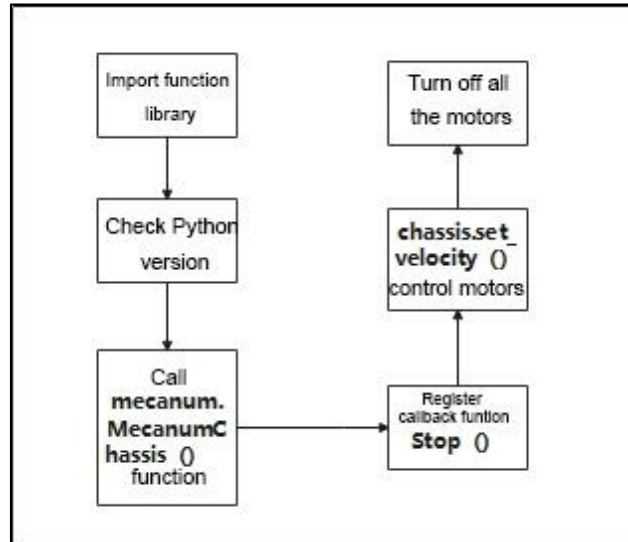
From the above figure, the program's logical flow is mainly divided into importing the function library, calling relevant functions, and controlling the motors. The following documentation will be written based on the program's logical flowchart mentioned above.

◆ **Import Function Library**

During initialization, the function library needs to be first imported for subsequent calling. For the detailed content of importing, please refer to "**3.1 Import Parameter Module**".

```
3    import sys
4    sys.path.append('/home/pi/MasterPi/')
5    import time
6    import signal
7    import HiwonderSDK.mecanum as mecanum
```

◆ **Check Python Version**

```
9   if sys.version_info.major == 2:
10      print('Please run this program with python3!')
11      sys.exit(0)
```

sys.version_info.major is used to check the major version of Python. If the version is equal to 2, the program will print a message and exit the program.

◆ **Call the mecanum.MecanumChassis（） function**

```
26      chassis = mecanum.MecanumChassis()
```

The call to **mecanum.MecanumChassis()** constructor creates an object of the **MecanumChassis** class and assigns it to the chassis variable .

◆ **Motor Control**

```
40   if __name__ == '__main__':
41      while start:
42          chassis.set_velocity(50,90,0)
43          time.sleep(1)
44
45      chassis.set_velocity(0,0,0)   # 关闭所有电机
46      print('已关闭')
47
48
```

Control motors primarily using the set_velocity function. There are three parameters in this function. Take the code "chassis.set_velocity(50,90,0)" as an example:

1) The first parameter "50" represents the motor speed, its unit is mm/s and it ranges from -100 to 100. When the value is negative, the motor rotates counterclockwise.

2) The second parameter "90" represents the movement direction of car, its unit is degree and it ranges from 0 to 360. The value of 90° refer to move forward. 270° refers to move backward. 0° refers to move to the right. 180°

refers to move the left. Other movement directions are obtained according to the same reference method.

3) The third parameter "0" represents the rotation speed of the car, its unit is radians per second and it ranges from -2 to 2. When the parameter value is positive, the car will rotate clockwise. When the parameter value is negative, the car will rotate counterclockwise.