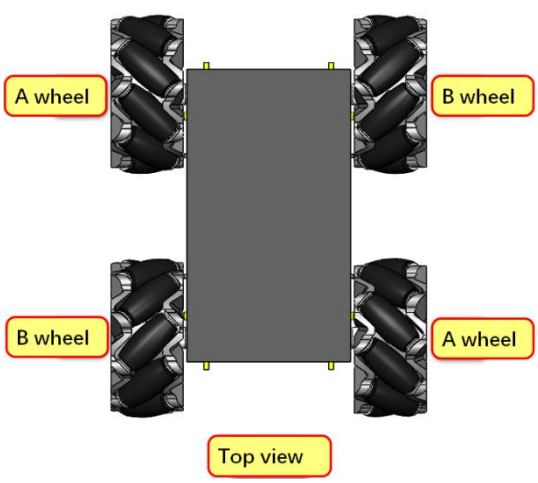
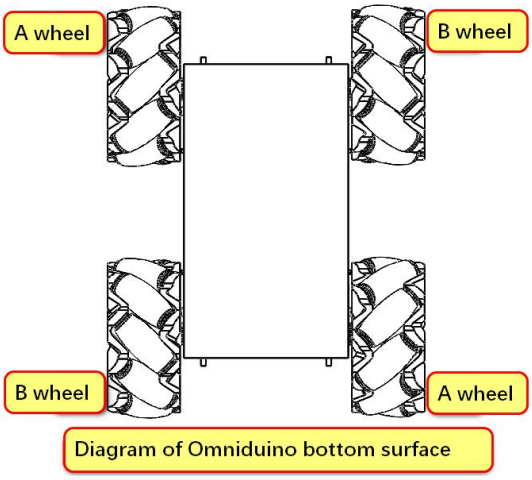
2.1.3Mecanum wheel movement principle

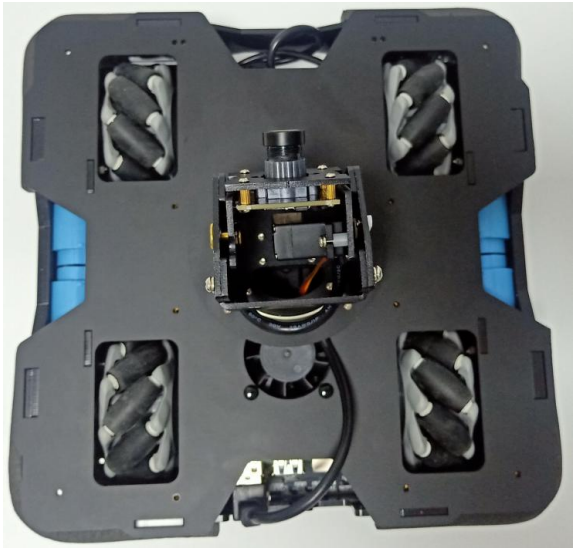
1. Installlation of Mecanum wheel on Raspblock Robot car

The only correct Mecanum wheel installation on the car should be [ABBA].



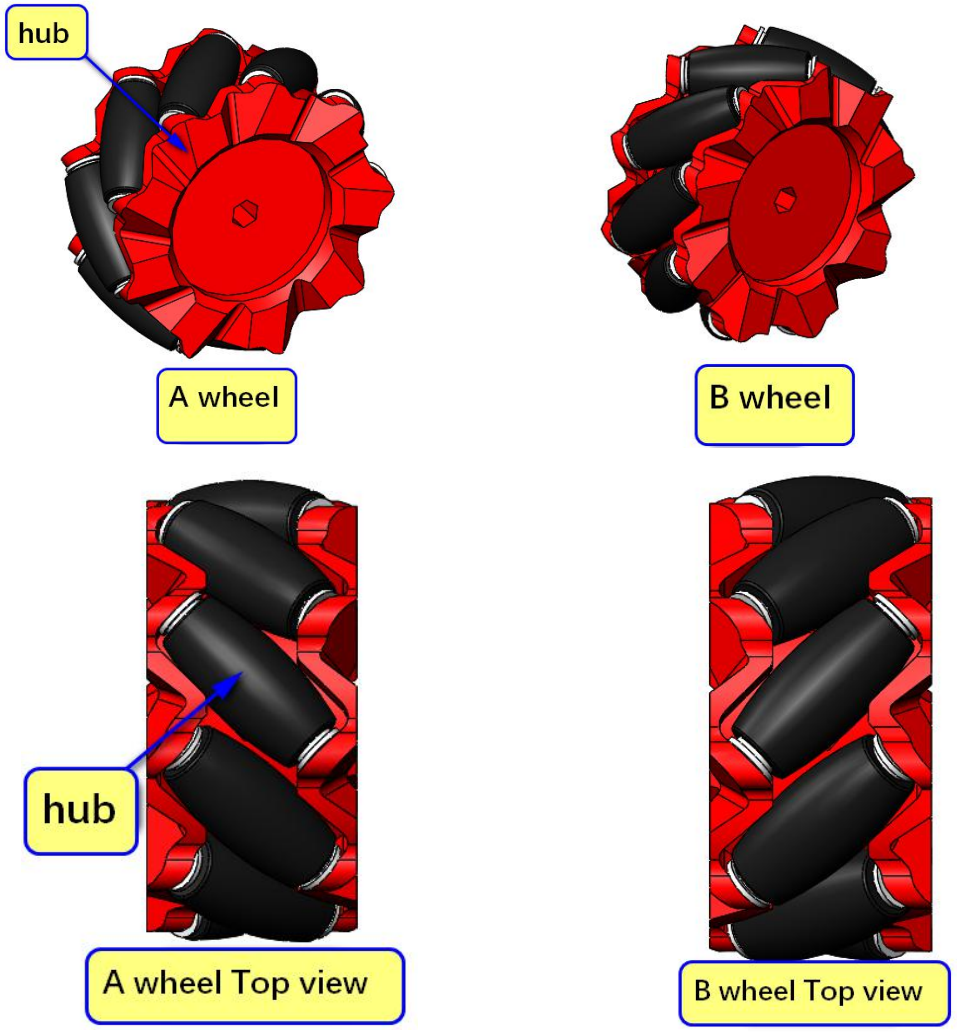


As shown below.



2. Introduction of Mecanum wheel

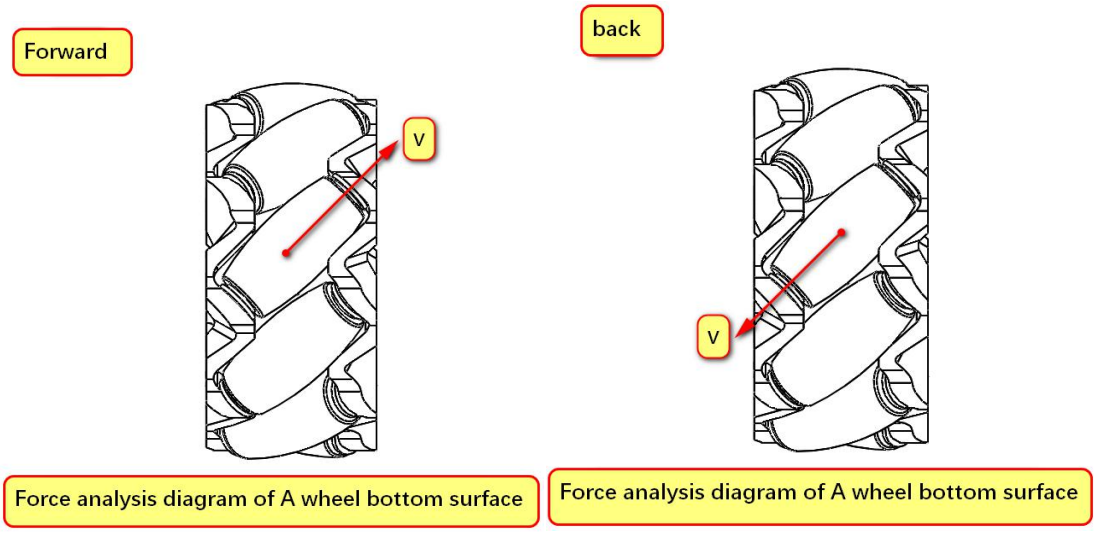
The Mecanum wheel is composed of a hub and a roller that surrounds the hub. The roller is a non-powered driven small roller. The angle between the Mecanum wheel roller axis and the hub axis is 45°. The Mecanum wheel contains two rounds of A and B that are mirror images of each other.



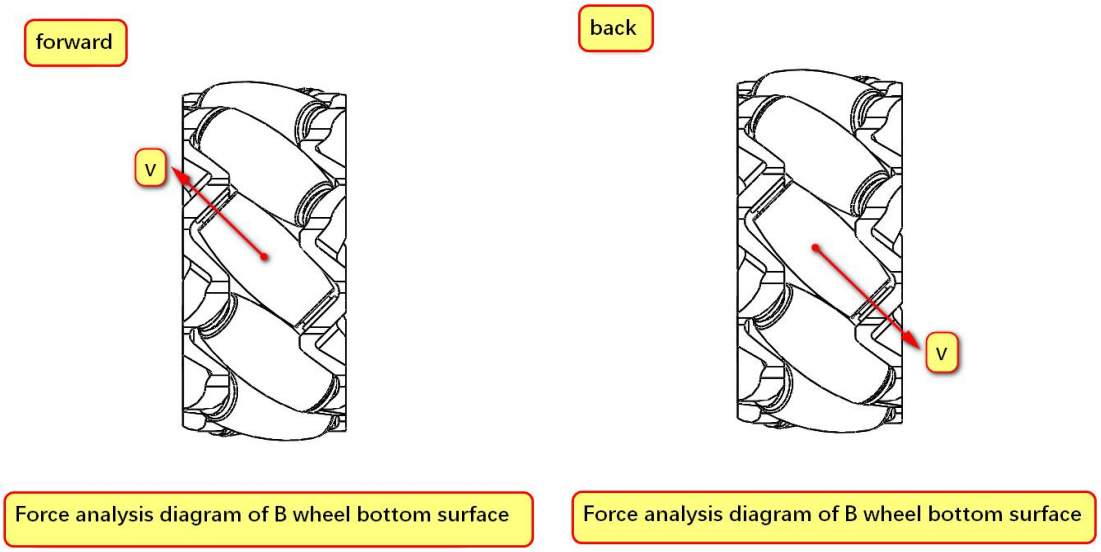
3. Mecanum Wheel Motion Analysis:

Mecanum wheel is divided into two types. When the A wheel moves forward, it also moves to the right, that is, obliquely to the right front. When the A wheel moves backwards, it also moves to the left, that is, obliquely to the left and rear. Similarly, the B wheel can be moved obliquely to the left front and the right rear.

In all the courses, we take the front of the car as the positive direction, and the direction in which the wheel advances is the forward rotation of the motor, and the direction in which the wheel retreats is the motor reversal.



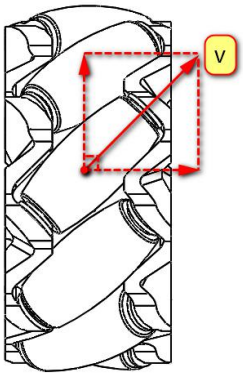
For the A wheel, the roller does not provide the forward force due to rolling in the moving direction, and the roller cannot roll in the direction of the roller axis and rubs against the ground to generate friction in the axial direction of the roller, that is, obliquely to the right front or left rear direction, thus A The speed direction of the wheel is obliquely right front or left rear.



According to the physics knowledge, we can know that the direction of the car body movement depends on the speed direction of the four Mecanum wheels. Then the A wheel can be decomposed into axially rightward and vertical axial forward velocity components, or axially leftward and vertical axially backwards.

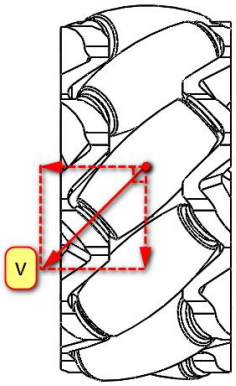
About A wheel:

forward



Force analysis diagram of A wheel bottom surface

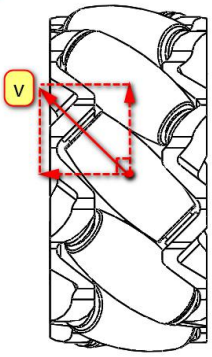
back



Force analysis diagram of A wheel bottom surface

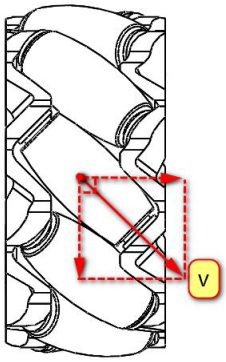
About B wheel:

forward



Force analysis diagram of B wheel bottom surface

back

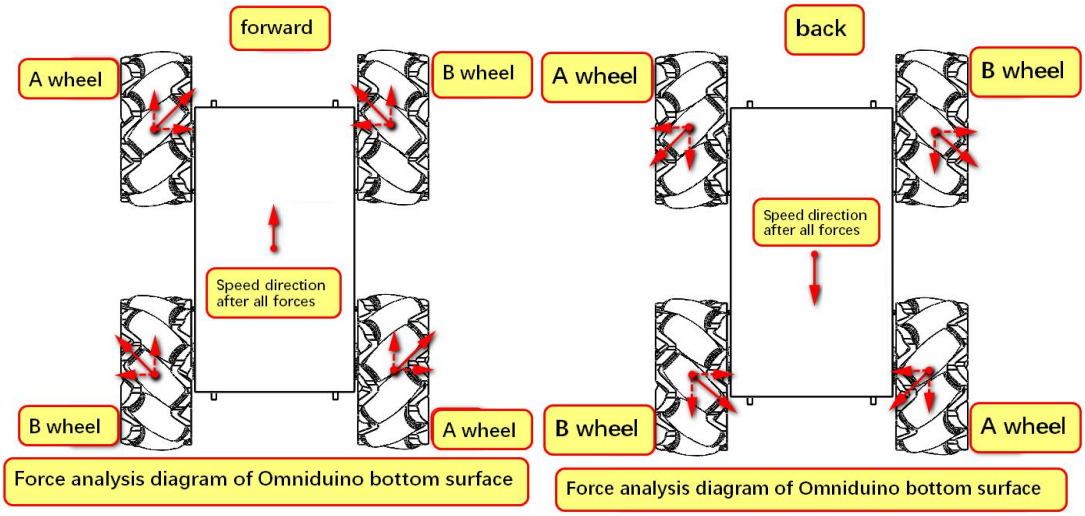


Force analysis diagram of B wheel bottom surface

4. Motion analysis of the 4 Mecanum wheels:

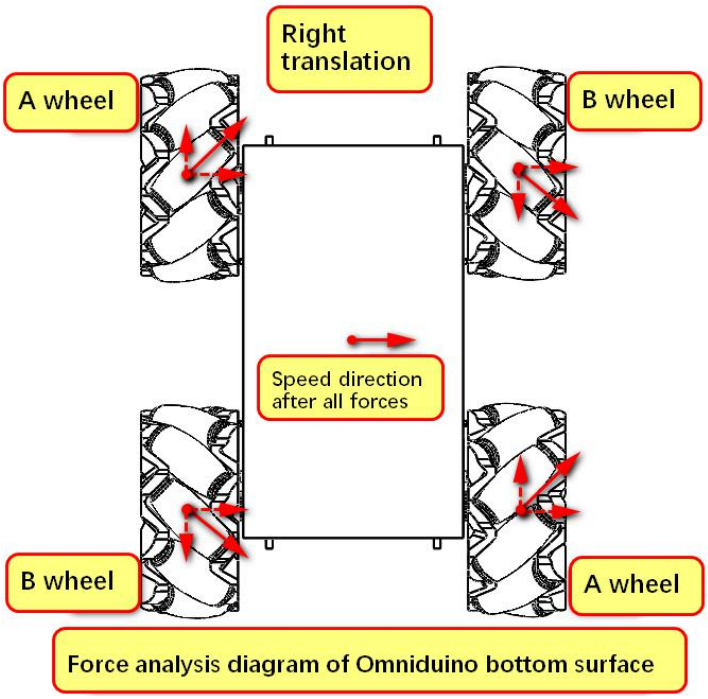
Case 1--Forward/Back

When all four wheels are turned forward, the A wheel and B wheel can cancel each other's axial speed, leaving only the forward speed, so that the car will advance. back are the same principle.



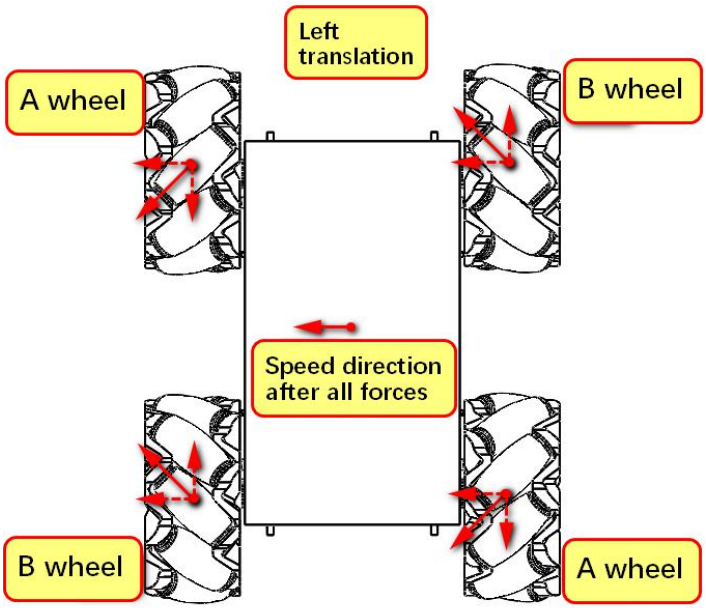
Case 2--Right translation

When the A wheel forward and the B wheel reverse, the forward and backward speeds will be offset, leaving only the speed to the right, then the car will translate to the right.



Case 3--Left translation

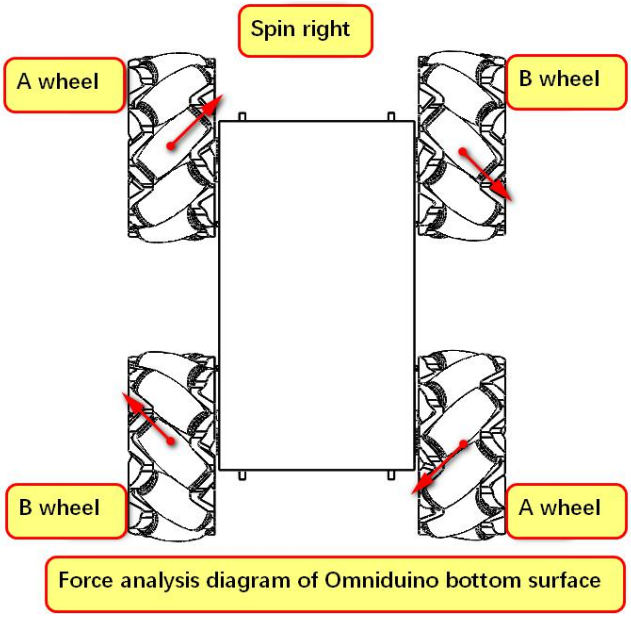
When the A wheel reverse and the B wheel is forward, the forward and backward speeds will be offset, leaving only the speed to the left, then the car will translate to the left.



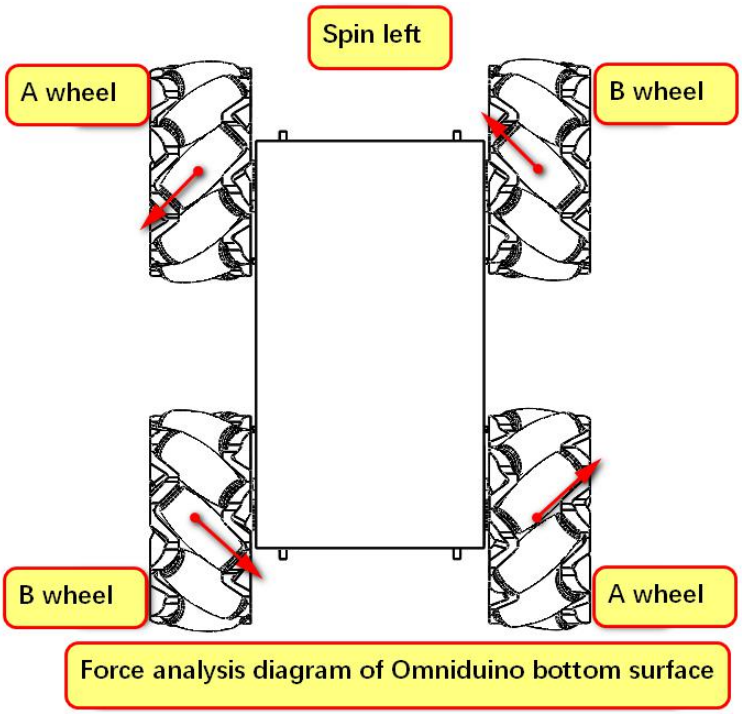
Force analysis diagram of Omniduino bottom surface

Case 4--Spin Left/Spin right

When left wheel of the chassis rotates forward and the right wheel reverse, so that car can be rotated to the right;
otherwise, the chassis will spin left.
When left wheel of the chassis rotates reverse and the right wheel reverse forward, so that car can be rotated to the left.



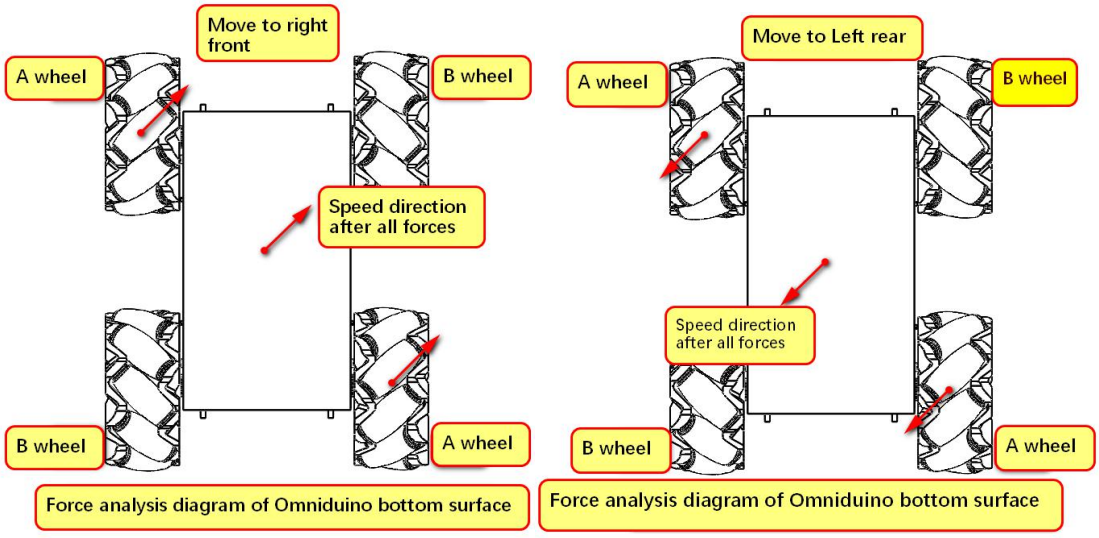
Force analysis diagram of Omniduino bottom surface



Case 5--Move to Right front/Left rear

When A wheel forward, B wheel stop, car will move to right front.

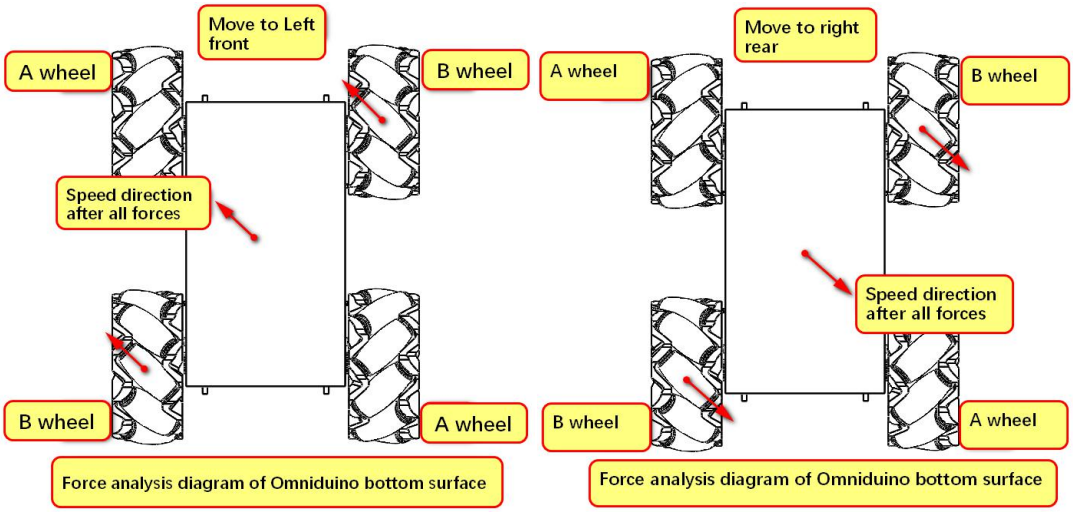
When B wheel reserve, B wheel stop, car will move to left rear.



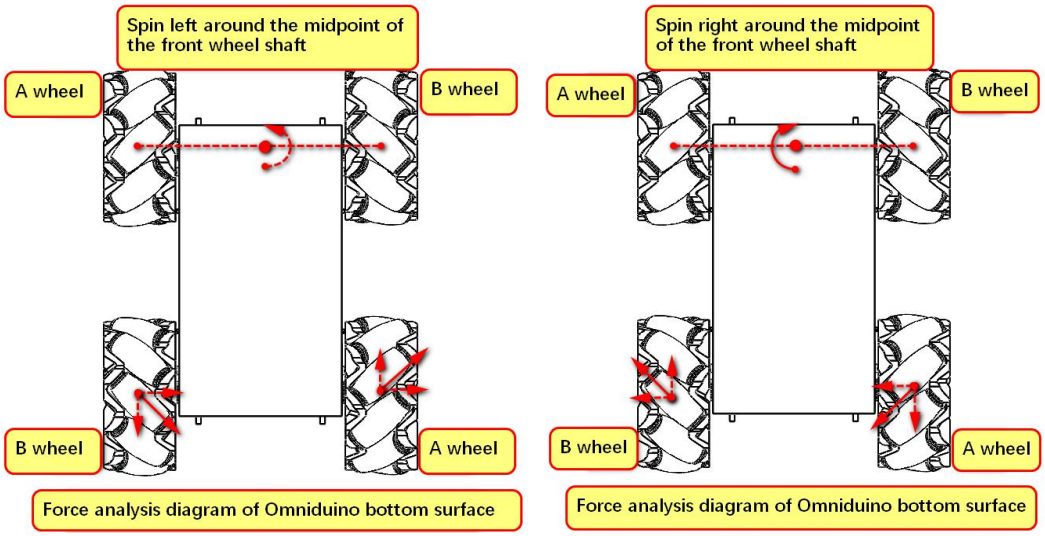
Case 6--Move to Right front/Left rear

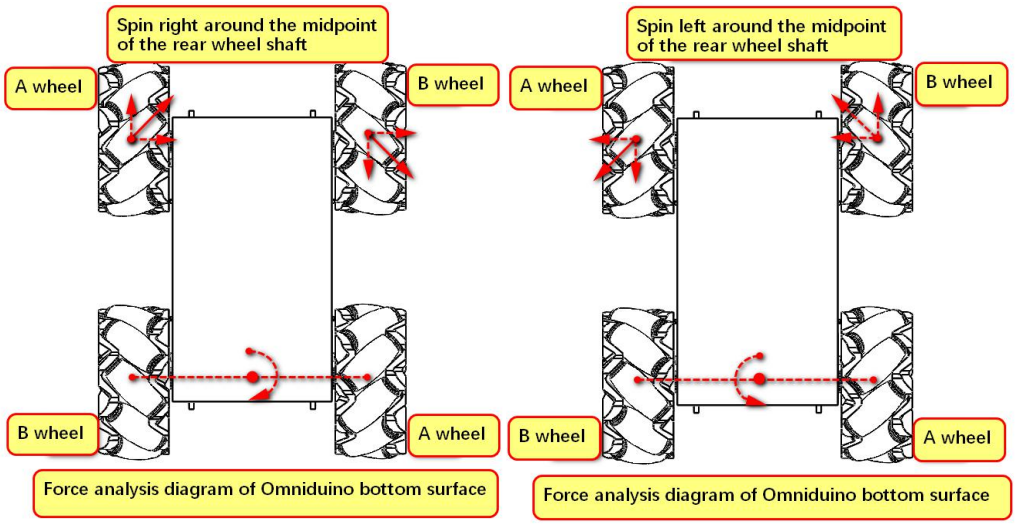
When A wheel stop, B wheel forward, car will move to left front.

When B wheel stop, A wheel reserve, car will move to right rear.



Case 7--Rotation around the midpoint of the axis

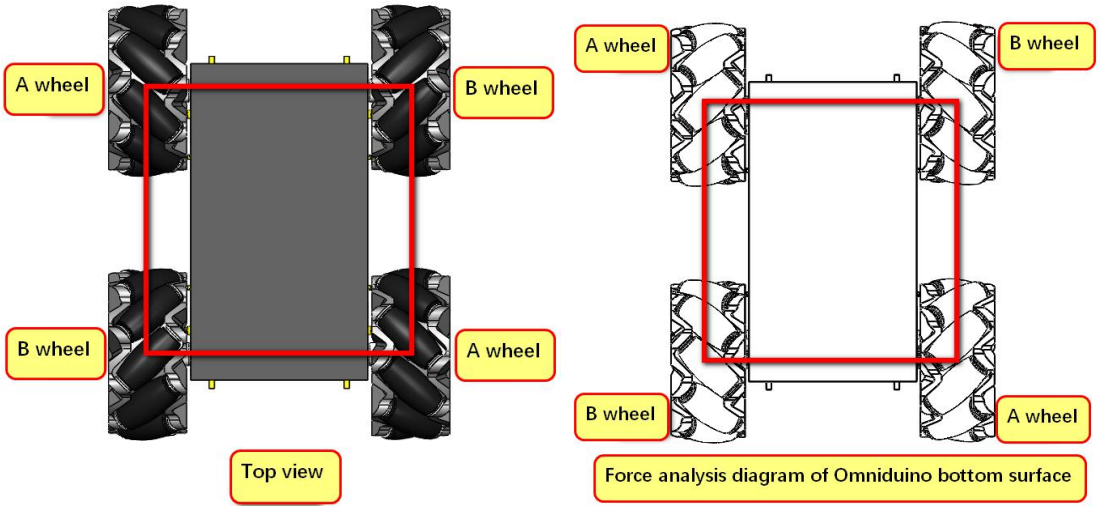




5. The installation position of the Mecanum wheel

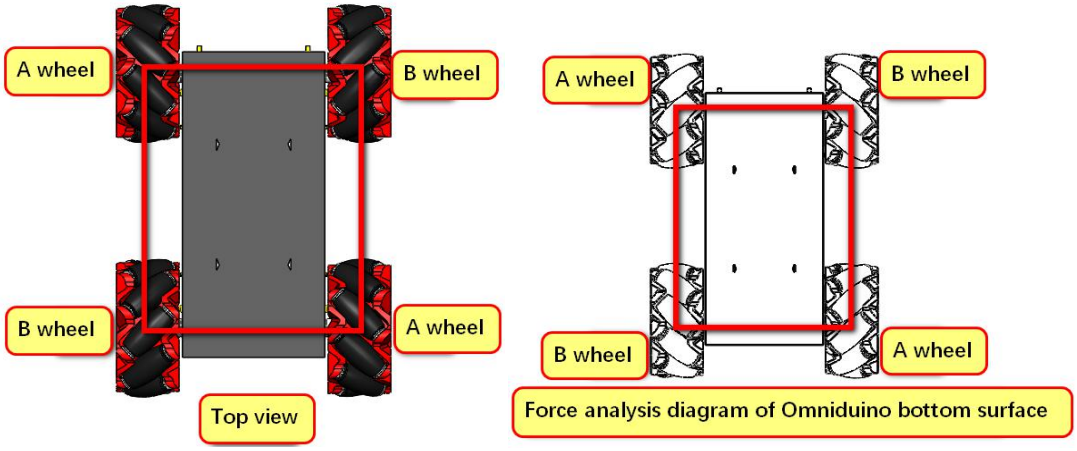
In the previous section, we explained the installation combination of the wheat wheel. After the installation, the four wheels and the ground contact points are mainly square and rectangular.

5.1 Square: Four wheels are located at the four vertices of the square, which can make translation and rotation can be done very well.



The chassis of the Omniduino is designed for the installation of the Mecanum wheel and is the ideal chassis for the McDonald.

5.2 Rectangle: The rotation of the wheel can produce the Yaw axis rotation torque, and the torque arm of the rotation torque is also relatively long. It is the most common way to install.

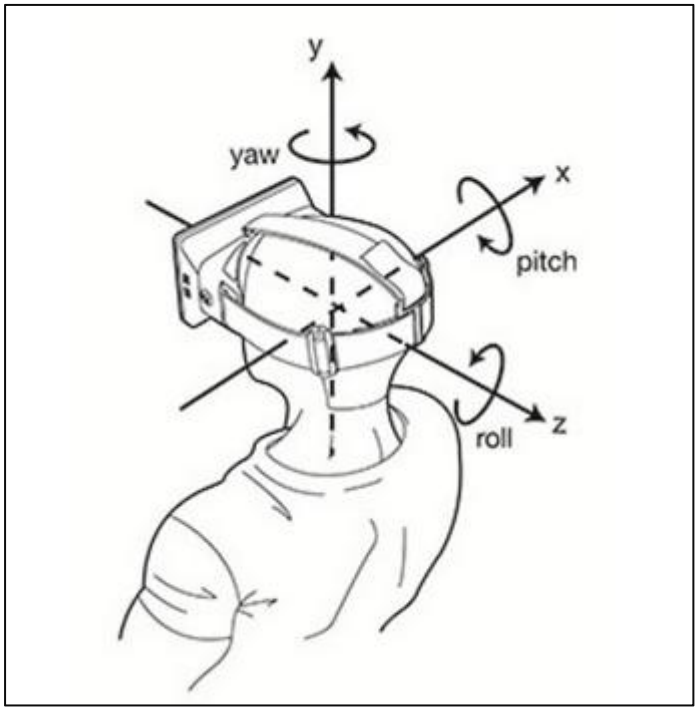


In the 3D system, assuming that the viewpoint is the origin, the viewpoint coordinate system is as shown in the following figure.

The pitch is rotated about the X axis, also called the pitch angle;

Yaw is rotated around the Y axis, also called yaw angle;

The roll is rotated around the Z axis, also called the roll angle.



Raspblock API function

1.Control motor Individually:
Speed_Wheel_control(Speed_WheelA, Speed_WheelB, Speed_WheelC, Speed_WheelD)
@Front of car
@|D A|
@|C B|
@ Range of speed:-25 ~ 25

2.Whole rocker mode control method
Speed_axis_Yawhold_control(Speed_axis_X, Speed_axis_Y) (with self-stabilization)
Speed_axis_control(Speed_axis_X, Speed_axis_Y, Speed_axis_Z) (without self-stabilization)
@Range of speed:
@X: -25 ~ 25
@Y: -25 ~ 25
@Z: 0 ~ 200

Code path:
/home/pi/Yahboom_Project/2Hardware_Control_course/3_Drive_*Mecanum wheel.ipynb*

```
# Method 1-Control motor Individually
```

```
@Import Raspblock drive library
from Raspblock import Raspblock
robot = Raspblock()
robot.Speed_Wheel_control(2, 0, 0, 0)          #Control wheel individually
robot.Speed_Wheel_control(2, 2, 2, 2)          #All wheel forward with 2 speed
robot.Speed_Wheel_control(-2, -2, -2, -2)       #All wheel reserve with 2 speed
robot.Speed_Wheel_control(2, 2, -2, -2)         #Spin left
robot.Speed_Wheel_control(-1, -1, 1, 1)         #Spin right
robot.Speed_Wheel_control(2, -2, 2, -2)         #Left translation
robot.Speed_Wheel_control(-2, 2, -2, 2)         #Right translation
robot.Speed_Wheel_control(0, 0, 0, 0)           #All wheel stop
# Keep moving for a while
for i in range(1, 5000):
      robot.Speed_Wheel_control(2, 2, 2, 2)
```

```
@Method 2 --Whole rocker mode control method
robot.Speed_axis_Yawhold_control(0, 2)     #Advance
robot.Speed_axis_Yawhold_control(0, -2)     # Back
robot.Speed_axis_Yawhold_control(-2, 0)     # Left translation
robot.Speed_axis_Yawhold_control(2, 0)      # Right translation
robot.Speed_axis_Yawhold_control(-2, 2)     # Upper left
robot.Speed_axis_Yawhold_control(2, 2)     # Upper right
robot.Speed_axis_Yawhold_control(-2, -2)    # Lower left
robot.Speed_axis_Yawhold_control(2, -2)     # Lower right
```

Gameplay introduction:

```
# Square translation
import time
robot.Speed_Wheel_control(-8, -8, 8, 8)       # Spin right
time.sleep(1)
robot.Speed_Wheel_control(-8, -8, -8, -8)     # All wheel reserve with 2 speed
time.sleep(1)
robot.Speed_Wheel_control(8, 8, -8, -8)       # Spin left
time.sleep(1)
robot.Speed_Wheel_control(8, 8, 8, 8)          # All wheel forward with 2 speed
time.sleep(1)
```

```
# Surround mode
@Library function: Speed_Wheel_control(Speed_WheelA, Speed_WheelB,
Speed_WheelC, Speed_WheelD)
@ Front of car
@ |D        A|
@ |C        B|
```

@Range of speed: -25 ~ 25 AD slow speed, BC fast speed to achieve the effect of surround mode

import time
robot.Speed_Wheel_control(-8, -15, 15, 8) # Right surround mode
time.sleep(5)
robot.Speed_Wheel_control(8, 15, -15, -8) # Left surround mode
time.sleep(5)

del robot # The object needs to be released after use, otherwise, when the next program needs to use this object module, it will be occupied and will become unusable