

EG114728 HD in AI and Robotics

MBS4544 Robot Sensing and Vision

Objectives and learning outcomes

In the end of this section, you will be able to:

1. Control robot car with mecanum wheels
2. Develop test codes on ESP32 to communicate with PS4 controller wirelessly via Bluetooth
3. Develop ESP32 codes to get data from PS4 controller and drive the robot car
4. Develop codes using IMU sensors to control the robot car wirelessly

Mecanum wheel (aka ilon wheels)



It is a conventional wheel with a series of rollers attached to its circumference, these rollers having an axis of rotation at 45° to the plane of the wheel in a plane parallel to the axis of rotation of the wheel. Depending on each individual wheel direction and speed, the resulting combination of all these forces produce a total force vector in any desired direction thus allowing the platform to move freely in the direction of the resulting force vector, without changing of the wheels themselves. Due to its versatile motion, it is perfect for tight space robot operation.

Application Examples



Kuka's monstrous robotic vehicle maneuvers gigantic Airbus components

KUKA omniMove transporter for the Airbus plant in Stade

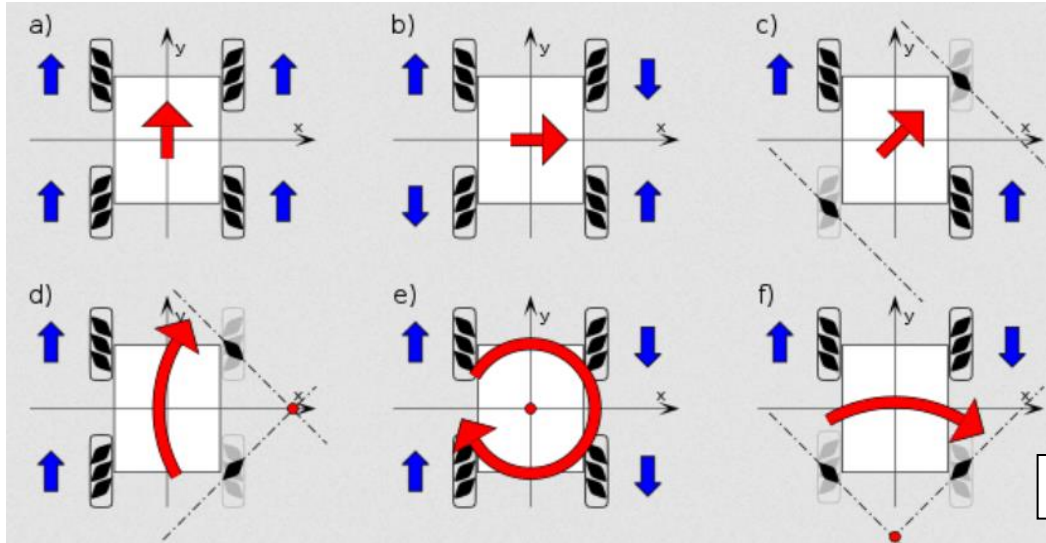
Reference:

https://www.youtube.com/watch?v=RZ_8xhCi72w

Characteristics

The four mecanum wheels are driven independently by controlling four individually connected motors. The robot can move forward, reverse and spin just like four regular wheels. The configuration of rollers at 45° also allows the robot to translate sideways and through a combination of these, in any direction. Force is split into two vectors, one forward/backward and one right/left. When the wheels on one side are spun in opposite directions, the forward and backward vectors cancel out while both sideways

vectors add up. Doing the reverse with the other two wheels results in four added sideways vectors. The following diagrams (**Figure 1** and **Figure 2**) give a better illustration of how the combination of the wheel motions to produce robot moving directions.

**Figure 1**

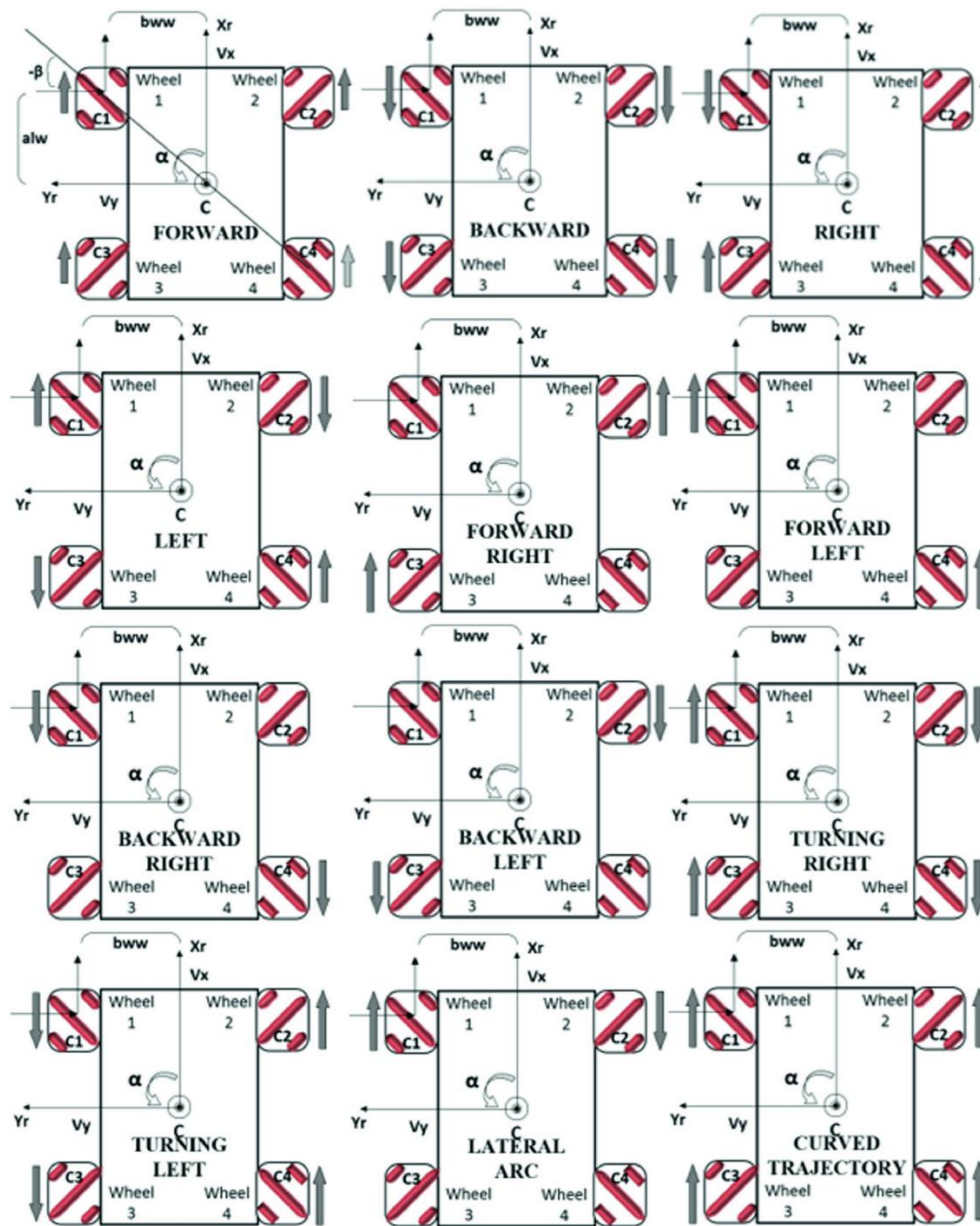


Figure 2

Assignment

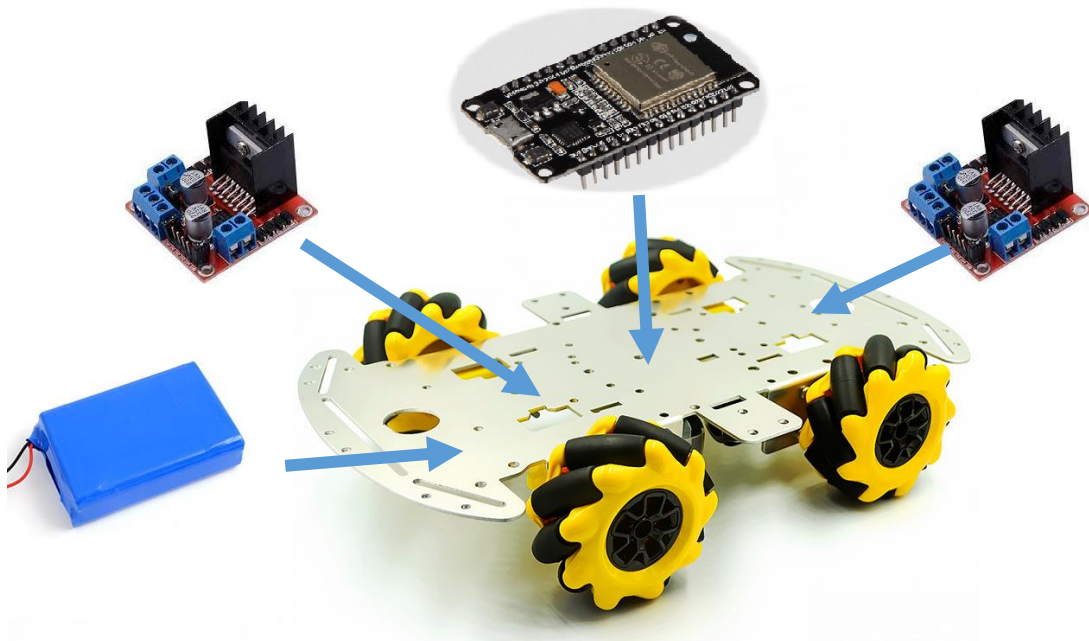
You may work in group of 2~3 classmates.

Deadline: 31 October 2022

Detail requirements will be given in Moodle.

Stage 1

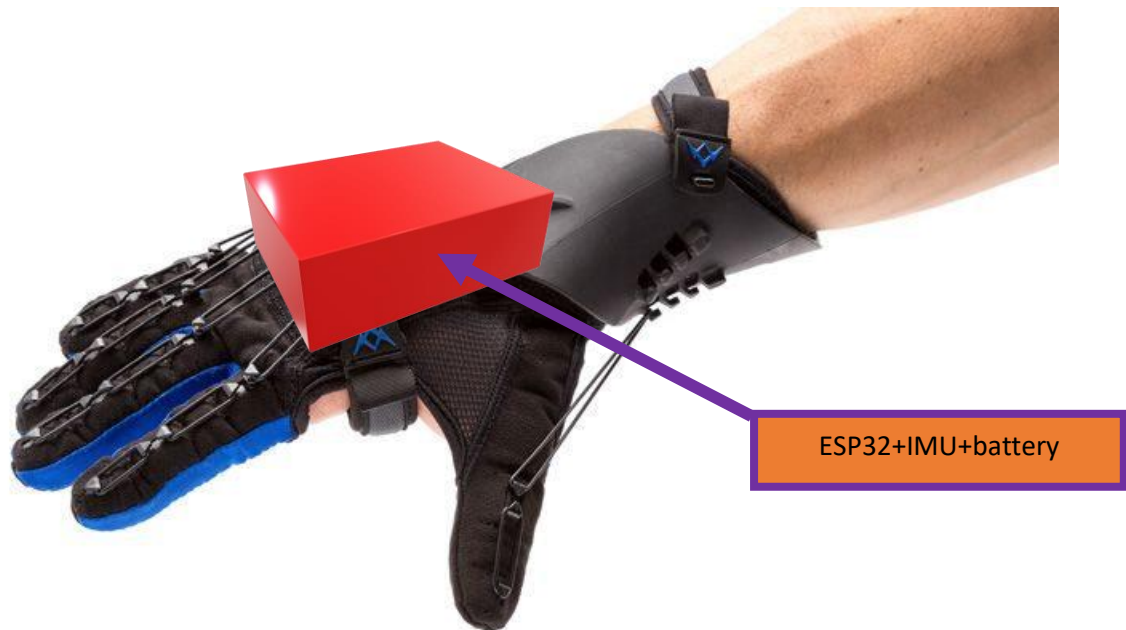
You are required to build a robot car with four mecanum wheels and develop a ESP32 code to drive the car by the PS4 controller.



PS4 Controller

Stage 2

Control the mecanum wheel robot car wirelessly by another ESP32 with an IMU connected. By tilting and rotating the IMU on your hand, the robot car should be able to move in the directions that is done in Stage 1.



Example code

case FORWARD:

```
rotateMotor(FRONT_RIGHT_MOTOR, MAX_MOTOR_SPEED);  
rotateMotor(BACK_RIGHT_MOTOR, MAX_MOTOR_SPEED);  
rotateMotor(FRONT_LEFT_MOTOR, MAX_MOTOR_SPEED);  
rotateMotor(BACK_LEFT_MOTOR, MAX_MOTOR_SPEED);  
break;
```

case BACKWARD:

```
rotateMotor(FRONT_RIGHT_MOTOR, -MAX_MOTOR_SPEED);  
rotateMotor(BACK_RIGHT_MOTOR, -MAX_MOTOR_SPEED);  
rotateMotor(FRONT_LEFT_MOTOR, -MAX_MOTOR_SPEED);  
rotateMotor(BACK_LEFT_MOTOR, -MAX_MOTOR_SPEED);  
break;
```

case LEFT:

```
rotateMotor(FRONT_RIGHT_MOTOR, MAX_MOTOR_SPEED);  
rotateMotor(BACK_RIGHT_MOTOR, -MAX_MOTOR_SPEED);  
rotateMotor(FRONT_LEFT_MOTOR, -MAX_MOTOR_SPEED);  
rotateMotor(BACK_LEFT_MOTOR, MAX_MOTOR_SPEED);  
break;
```

case RIGHT:

```
rotateMotor(FRONT_RIGHT_MOTOR, -MAX_MOTOR_SPEED);  
rotateMotor(BACK_RIGHT_MOTOR, MAX_MOTOR_SPEED);  
rotateMotor(FRONT_LEFT_MOTOR, MAX_MOTOR_SPEED);  
rotateMotor(BACK_LEFT_MOTOR, -MAX_MOTOR_SPEED);  
break;
```

Reference:

https://github.com/wysh2503/MBS4544_Robot_Sensing_and_Vision/blob/main/PS4-ESP32-MecanumWheel/PS4-ESP32-MecanumWheel.ino