

Car Follow Hand

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Use the K1 button to control the on and off of the car's ultrasonic following function.

Since the previous tutorial has explained the basic knowledge of all car modules, the car control tutorial will not repeat it, and will mainly explain the ideas for implementing the car functions!

Device connection

Hardware connection

Use the Type-B data cable to connect Arduino Uno and the computer.

Software connection

Open the "Arduino IDE" software and select the model and serial port number corresponding to the development board.

Implementation ideas

Get the distance of the object in front through the ultrasonic module, and control the movement of the car based on the distance information.

Button K1: Turn on or off the car following function;

Ultrasonic module: Get the distance of the object in front of the car;

Car control:

The object in front of the car is less than the set distance (15cm): the car retreats;

The object in front of the car is greater than the set distance interval (30-50cm): the car moves forward;

The object in front of the car is in the set distance interval (15-30cm) or greater than the set distance (50cm): the car stops.

Code Analysis

Here we only briefly introduce the code content. For detailed code, please refer to the corresponding code file, which is provided in the download area!

- Include `wire`、`Adafruit_PWMServoDriver` library

```
#include <Wire.h> // 包含Wire(I2C)通讯库 Include wire library
#include <Adafruit_PWMServoDriver.h> // 包含Adafruit PWM servo driver库 Include Adafruit PWM servo driver library
```

- Define the motor, button, ultrasonic control pin, I2C address, motor frequency and initial speed

```
// 定义电机控制引脚 Define motor control pins
#define Motor_L1_F_PIN 11 // 控制小车左前方电机前进 Control the motor on the left front of the car
#define Motor_L1_B_PIN 10 // 控制小车左前方电机后退 Control the motor back on the left front of the car
#define Motor_L2_F_PIN 8 // 控制小车左后方电机前进 Control car left rear motor forward
#define Motor_L2_B_PIN 9 // 控制小车左后方电机后退 Control the car left rear motor back
#define Motor_R1_F_PIN 13 // 控制小车右前方电机前进 Control the right front motor of the car to move forward
#define Motor_R1_B_PIN 12 // 控制小车右前方电机后退 Control the motor back on the right front of the car
#define Motor_R2_F_PIN 14 // 控制小车右后方电机前进 Control car right rear motor forward
#define Motor_R2_B_PIN 15 // 控制小车右后方电机后退 Control car right rear motor back

// 定义底层驱动芯片参数 Bottom-layer driver chip related parameters
#define Bottom_Layer_Driver_ADDR 0x40

// 定义PWM频率 Define PWM frequency
```

```
#define PWM_FREQUENCY 50

// 定义按键引脚和控制状态 Define pin and key(button) states
#define KEY_PIN 7
#define Press_KEY 0
#define Release_KEY 1

// 定义超声波模块控制引脚 Define ultrasonic control pins
#define TRIG_PIN 11
#define ECHO_PIN 12

bool bCar_Switch = false;

int iCarSpeed = 50;
float Distance = 0.0;
const float FarDistance = 50.0;
const float MidDistance = 30.0;
const float NearDistance = 15.0;
```

- Enumerate the common movement modes of omnidirectional cars

```
// 枚举全向小车的常见运动方式 Enumerate the common movement modes of omnidirectional cars
enum OmniDirectionalCar {
    STOP,
    FORWARD,
    BACKWARD,
    LEFT,
    RIGHT,
    LEFT_ROTATE,
    RIGHT_ROTATE,
    LEFT_FORWARD,
    RIGHT_BACKWARD,
    RIGHT_FORWARD,
    LEFT_BACKWARD,
};
```

- Create an instance of the Adafruit_PWMServoDriver class

```
// 创建Adafruit_PWMServoDriver类的实例 Create an instance of the Adafruit_PWMServoDriver class
Adafruit_PWMServoDriver pwm = Adafruit_PWMServoDriver(Bottom_Layer_Driver_ADDR);
```

- Setting the Motor Speed

```
/**
 * @brief 设置单个电机速度 Setting the Motor Speed
 * @param motor_forward_pin: 控制电机前进引脚 Control the motor forward pin
 * @param motor_backward_pin: 控制电机后退引脚 Control the motor backward pin
 * @param motor_speed: 设置电机速度 Setting the Motor Speed
 * @retval 无 None
 */
void setMotorSpeed(uint16_t motor_forward_pin, uint16_t motor_backward_pin, int motor_speed) {
    motor_speed = map(motor_speed, -255, 255, -4095, 4095);
    if (motor_speed >= 0) {
        pwm.setPWM(motor_forward_pin, 0, motor_speed);
        pwm.setPWM(motor_backward_pin, 0, 0);
    } else if (motor_speed < 0) {
        pwm.setPWM(motor_forward_pin, 0, 0);
        pwm.setPWM(motor_backward_pin, 0, -(motor_speed));
    }
}
```

- Set the car movement mode and speed

```
/**
 * @brief 设置小车运动方式和速度 Set the car movement mode and speed
 * @param Movement: 小车运动方式 Car movement
 * @param Speed: 小车运动速度 Car speed
 * @retval 无 None
 */
```

```

void setCarMove(uint8_t Movement, int Speed) {
    switch (Movement) {
        case STOP:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, 0);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, 0);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, 0);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, 0);
            break;
        case FORWARD:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, Speed);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, Speed);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, Speed);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, Speed);
            break;
        case BACKWARD:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, -Speed);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, -Speed);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, -Speed);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, -Speed);
            break;
        case LEFT:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, -Speed);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, Speed);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, Speed);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, -Speed);
            break;
        case RIGHT:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, Speed);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, -Speed);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, -Speed);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, Speed);
            break;
        case LEFT_ROTATE:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, -Speed);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, -Speed);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, Speed);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, Speed);
            break;
        case RIGHT_ROTATE:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, Speed);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, Speed);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, -Speed);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, -Speed);
            break;
        case LEFT_FORWARD:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, 0);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, Speed);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, Speed);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, 0);
            break;
        case RIGHT_BACKWARD:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, 0);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, -Speed);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, -Speed);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, 0);
            break;
        case RIGHT_FORWARD:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, Speed);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, 0);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, 0);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, Speed);
            break;
        case LEFT_BACKWARD:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, -Speed);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, 0);
            setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, 0);
            setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, -Speed);
            break;
        default:
            setMotorSpeed(Motor_L1_F_PIN, Motor_L1_B_PIN, 0);
            setMotorSpeed(Motor_L2_F_PIN, Motor_L2_B_PIN, 0);
    }
}

```

```

        setMotorSpeed(Motor_R1_F_PIN, Motor_R1_B_PIN, 0);
        setMotorSpeed(Motor_R2_F_PIN, Motor_R2_B_PIN, 0);
        break;
    }
}

```

- Get key(button) status

```

/**
 * @brief 获取按键状态 Get key(button) status
 * @param pin: 按键控制引脚 Control key(button) pins
 * @retval 按键状态 Key(button) Status
 */
int getKeyState(uint8_t pin) {
    if (digitalRead(pin) == LOW) {
        delay(20);
        if (digitalRead(pin) == LOW) {
            while (digitalRead(pin) == LOW)
                ;
            return Press_KEY;
        }
        return Release_KEY;
    } else {
        return Release_KEY;
    }
}

```

- Get ultrasonic distance

```

/**
 * @brief 获取超声波距离 Get ultrasonic distance
 * @param trigPin: 触发测距引脚 Trigger pin
 * @param echoPin: 接收测距引脚 Echo pin
 * @retval 转换的距离 Measured distance (cm)
 */
float getDistance(int trigPin, int echoPin) {
    pinMode(trigPin, OUTPUT);
    pinMode(echoPin, INPUT);

    digitalWrite(trigPin, HIGH);
    delayMicroseconds(10);
    digitalWrite(trigPin, LOW);

    long duration = pulseIn(echoPin, HIGH);
    float distance = (duration * 0.034 / 2);
    return distance;
}

```

- Car following function

```

/**
 * @brief 小车跟随功能 Car following function
 * @param 无 None
 * @retval 无 None
 */
void Car_Follow() {
    Distance = getDistance(TRIG_PIN, ECHO_PIN);
    Serial.println(Distance);
    delay(10);
    if (Distance < NearDistance) {
        setCarMove(BACKWARD, iCarSpeed);
    } else if ((NearDistance <= Distance && Distance <= MidDistance) | (Distance >= FarDistance)) {
        setCarMove(STOP, iCarSpeed);
    } else if (MidDistance < Distance < FarDistance) {
        setCarMove(FORWARD, iCarSpeed);
    } else {
        setCarMove(STOP, iCarSpeed);
    }
}

```

- Set the car function switch

```
/**
 * @brief 设置小车功能开关 Set the car function switch
 * @param 无 None
 * @retval 开启/关闭 true/false
 */
bool setCarSwitch() {
    if (getKeyState(KEY_PIN) == Press_KEY) {
        bCar_Switch = !bCar_Switch;
    }
    return bCar_Switch;
}
```

- Initialization Code

```
void setup() {
    wire.begin();           // 初始化I2C通讯 Initialize I2C communication
    delay(1000);             // 如果小车功能异常，可以增加这个延时 If the function is abnormal, you can
                             // increase the delay
    pwm.begin();             // PWM初始化 Initialize the Pulse width Modulation (PWM) library
    pwm.setPWMFreq(PWM_FREQUENCY); // 设置PWM频率 Set the PWM frequency
    setCarMove(STOP, 0);     // 设置小车停止状态 Set the car to stop state
}
```

- Looping code

```
void loop() {
    // 按键控制小车跟随功能启停 The key control car follow function start and stop
    if (setCarSwitch()) {
        Car_Follow();
    } else {
        setCarMove(STOP, 0);
    }
}
```

Experimental results

After compiling the program successfully, upload the code to the Arduino Uno development board.

After the program starts, press the K1 button to start and stop the car's ultrasonic following function.

Actual use: We can put the car on a flat ground, press the K1 button to start the car function, and then put your hand in front of the car's ultrasonic wave to observe the entire following effect. If you need to stop the following function, you can press the K1 button to turn off the car's following function.

The drive motor needs an external battery pack and turn on the expansion board switch to drive normally. The burning program cannot use other programs to occupy the serial port or an external serial communication module (for example: WiFi camera module), otherwise the program cannot be burned or an error message will be prompted!