Electromagnetic tracking

The tutorial mainly demonstrates the line patrol function of the balance car combined with the electromagnetic line patrol module.

```
The tutorial only introduces the standard library engineering code
```

Hardware connection

| Peripherals	Development board
Electromagnetic line patrol: ADC1-L1	PC0
Electromagnetic line patrol: ADC2-L2	PC1
Electromagnetic line patrol: ADC3-L3	PC2
Electromagnetic line patrol: ADC4-L4	PC3
Electromagnetic line patrol: ADC5-L5	PC4
Electromagnetic line patrol: ADC6-L6	PC5
Electromagnetic line patrol: ADC7-L7	PB0
Electromagnetic line patrol: NC	Not connected
Electromagnetic line patrol: GND	GND
Electromagnetic line patrol: GND	GND

Control principle

The ADC data collected by the electromagnetic line patrol module is processed by the normalization algorithm through the program, and the processed data is compared with the program median value as the PID control error of the electromagnetic line patrol.

```
Using the normalization algorithm can better feedback the position of the
electromagnetic sensor on the electromagnetic wire
```
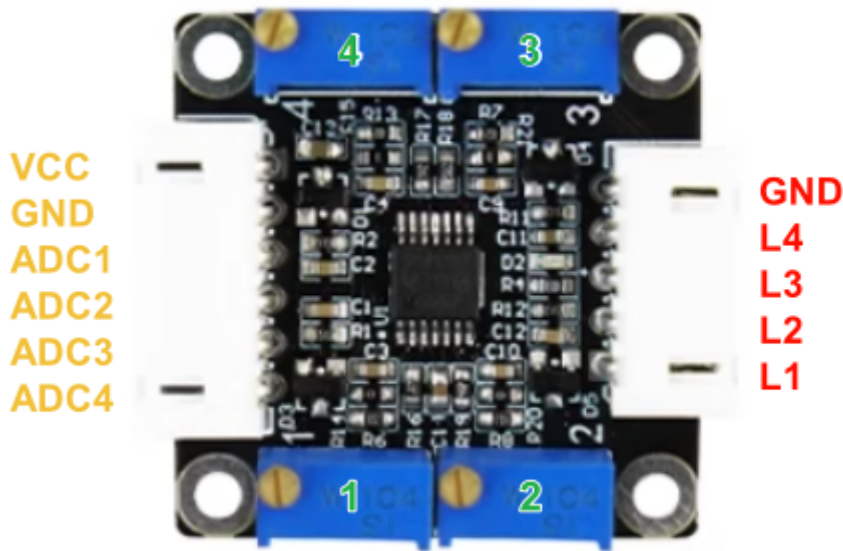
- Electromagnetic line patrol module

The electromagnetic line patrol module consists of an electromagnetic line patrol probe module and an operational amplifier.
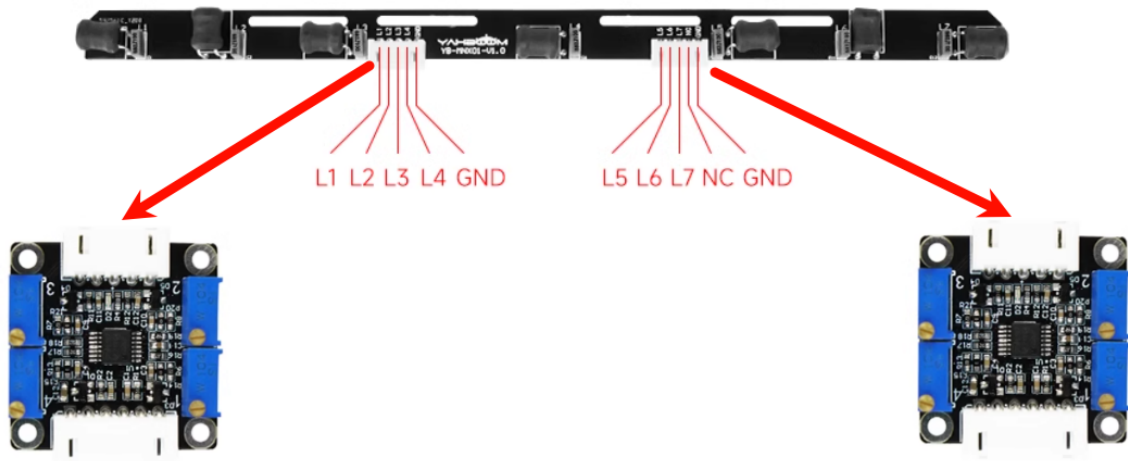
- Electromagnetic line patrol probe module

L1 L2 L3 L4 GND   L5 L6 L7 NC GND
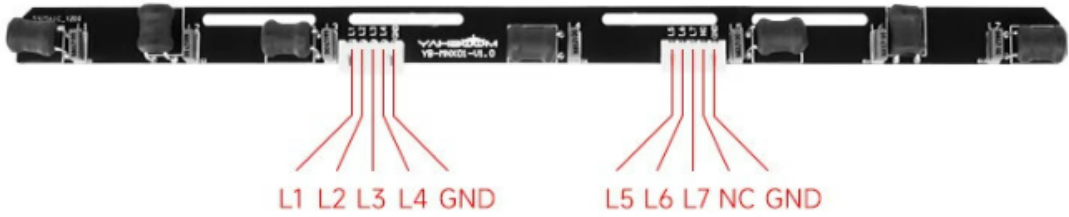
Peripherals	Description
Electromagnetic line patrol: L1-L7	Induction signal output pin: need to connect to operational amplifier
Electromagnetic line patrol: GND	Power supply pin: GND
Electromagnetic line patrol: NC	Do not connect

- Operational amplifier

Peripherals	Description
Operational amplifier: VCC	Power supply pin: 3.3-5V
Operational amplifier: GND	Power supply pin: GND
Operational amplifier: L1-L4	Sensing signal input pin: electromagnetic line patrol probe module
Operational amplifier: ADC1-ADC4	Gained signal: connected to MCU's IO port
Operational amplifier: 1-4	Gain potentiometer: gain adjustment

L1 L2 L3 L4 GND   L5 L6 L7 NC GND

The gain potentiometer needs to be adjusted before use: Place each inductor of the electromagnetic line patrol probe module vertically in the same position directly above the enameled wire of the electromagnetic signal generator, and adjust the gain potentiometer so that the output voltage after the operational amplifier is basically consistent (the voltage is determined by the ADC data converted by the MCU).

Main code

The tutorial mainly explains the code for implementing the CCD line patrol and obstacle avoidance function. For detailed code, refer to the corresponding project file.

> **Turn_ELE_PD**

Electromagnetic line patrol PID implementation function. If the line patrol effect of the balance car is not good, modify the PID parameters of the app_ele_tracking.c file. It is not recommended to modify the PID parameters of the pid_control.c file (the PID parameters of the pid_control.c file are subject to the parameters finally confirmed in the balance car parameter adjustment tutorial).

```c
int Turn_ELE_PD(float gyro)
{
    if(ele_seat==0)
    {
        return 0;
    }

    int ELETurn = 0;
    float err = 0;

    err=ele_seat-ELE_Minddle;

    ELETurn=err*ELE_Trun_KP+gyro*ELE_Trun_KD;

    return ELETurn;
}
```

> **Set_track_speed**
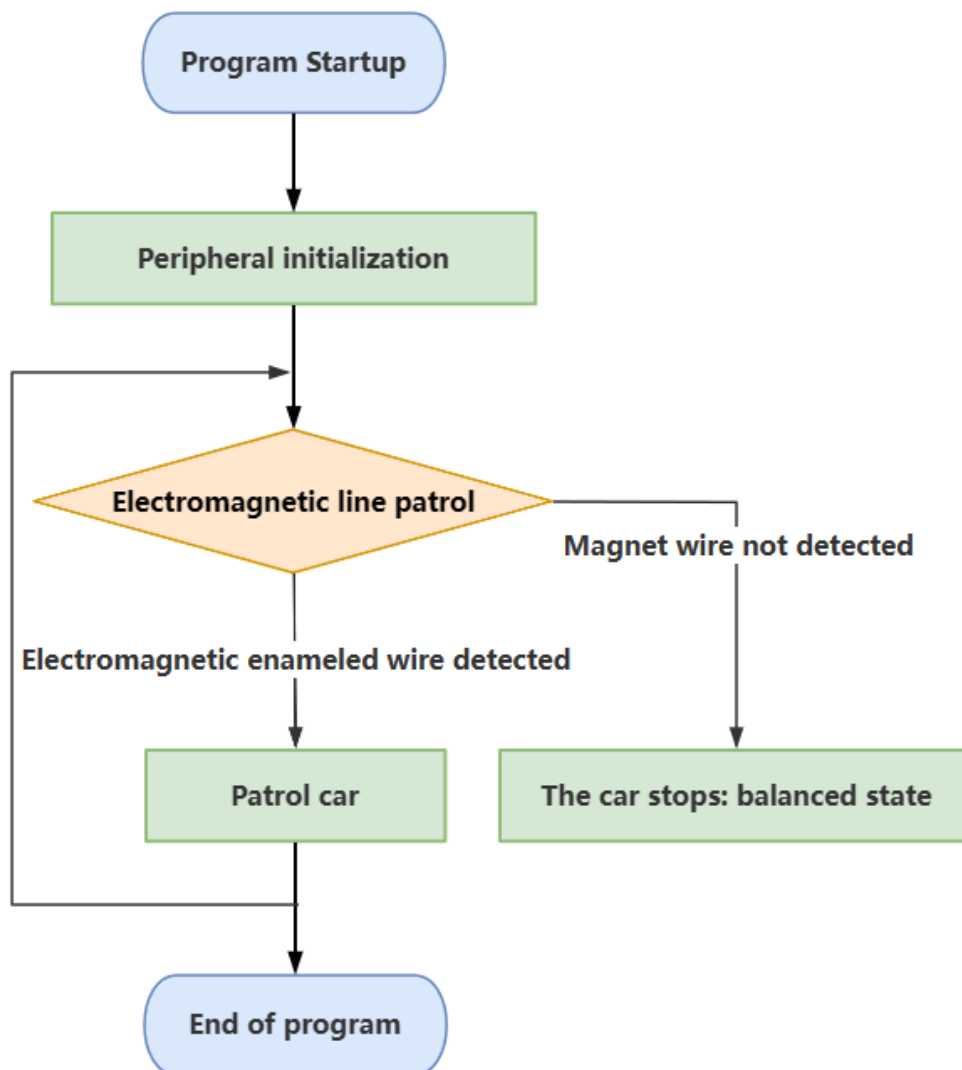
```
void Set_track_speed(void)
{
    if(ele_seat==0)// Not within the magnetic field
    {
        Move_X = 0;// stop
        return;
    }

    Move_X = Track_Speed;
}
```

Program flow chart

Briefly introduce the process of function implementation:

Experimental phenomenon

> **Software code**

The ELE_Car_Line.hex file generated by the project compilation is located in the OBJ folder of the ELE_Car_Line project. Find the ELE_Car_Line.hex file corresponding to the project and use the FlyMcu software to download the program into the development board.

```
Product supporting data source code path: Attachment → Source code summary →
5.Balanced_Car_Extended → 06.ELE_Car_Line
```

After the program is started, put the car on the patrol map, and press KEY1 according to the OLED prompt to start the electromagnetic patrol function of the balance car: OLED displays the values processed by the normalized algorithm and the sensor values vertical to the electromagnetic enameled wire (L3, L1, MID, R1, R3) in real time; if the electromagnetic patrol module does not detect the electromagnetic enameled wire, the balance car will stop moving and maintain a balanced state.

```
The program has voltage detection. If the voltage is less than 9.6V, the low
voltage alarm is triggered and the buzzer will sound.
Common situations for triggering voltage alarms:
1. The power switch of the development board is not turned on, and only the Type-
C data cable is connected for power supply
2. The battery pack voltage is lower than 9.6V and needs to be charged in time
```