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Intelligent vehicle based on STM32 to complete material handling after visual recognition

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Abstract

In today's society, the demand for industrial handling is increasing, and speed, accuracy, and stability are constantly improving. An intelligent material handling vehicle designed in this paper completes the sorting of different objects in the specified site, and then completes the material handling according to the optimal path planning algorithm. stm32f1 is adopted as the main control unit and equipped with gray scale sensor to complete the line patrol task. The openmv module used for material color recognition by pT-head robot arm can realize automatic handling and save human resources through mechanical structure design, chassis driving and visual processing.

Keywords

Mechanical arm, STM32, Openmv.

1. Introduction

With the development of urbanization and the progress of scientific and technological level, the demand for intelligent logistics handling is increasing in urban docks, earthquake disaster relief, household material handling, and campus equipment transportation. Among them, material identification accuracy, transfer operation stability, optimal path planning, and data cloud sharing need to be improved.

In order to simulate the above scenario and realize automatic material handling in a specific scenario, a standard map is designed. The dimensions of departure area and return area are 300×300mm, and the colors are blue and red respectively. The size of the material storage area is 400×300mm, and the color is yellow. The main task of the robot is to independently identify the materials in the material storage area, pick up and move the materials to the material storage area, and place the material storage area into the specified material storage area.

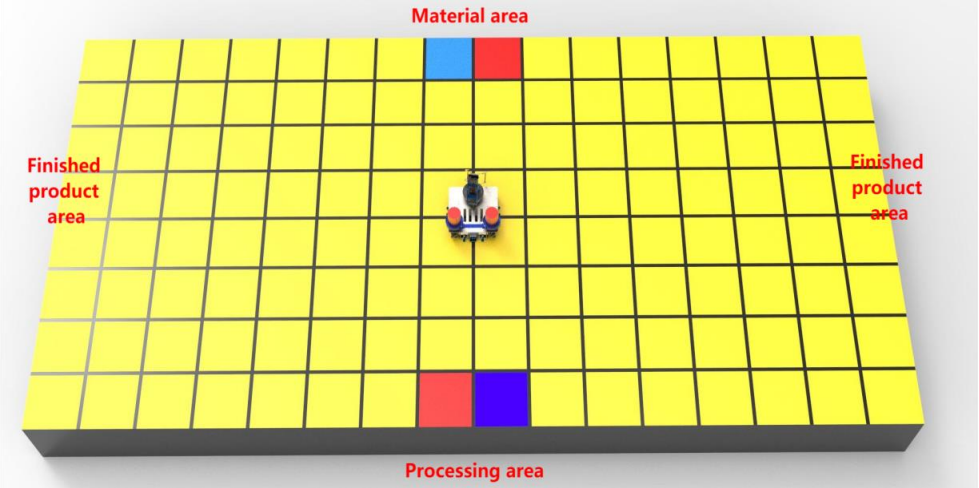

Figure 1: Map description

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2. Mechanical Structure

The intelligent vehicle is equipped with a mechanical arm, a wheat wheel and a drive motor, an end actuator of the mechanical arm, an openmv fixing plate, a pith, a gray scale sensor fixing card slot, and a main control board fixing platform. The shape of the material is a cylindrical body with an outer diameter of 75mm, a height of 100mm and a weight of not more than 200g. The maximum external dimensions of the truck are projected in the vertical direction in a square with a side length of 280mm and a height of 387mm.

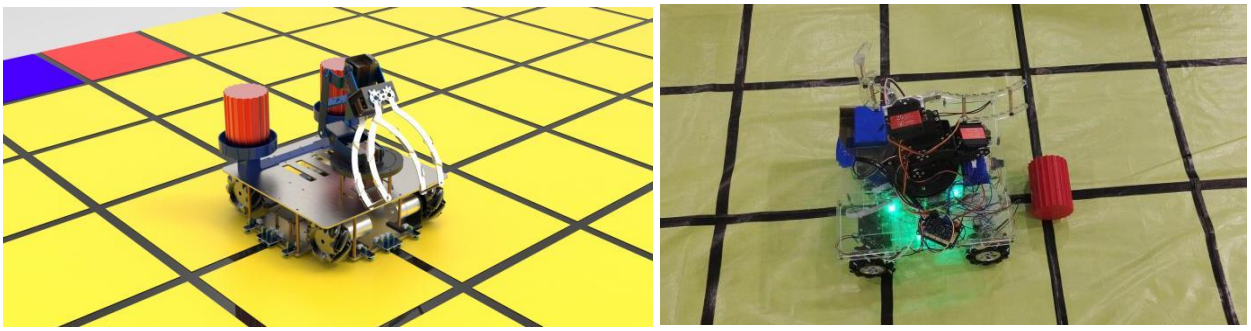

Figure 2: Mechanical structure display

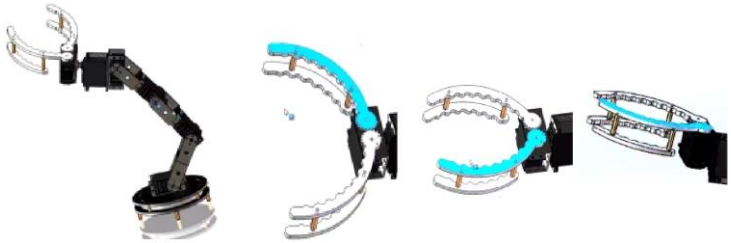

Figure 3: Work diagram of mechanical claw

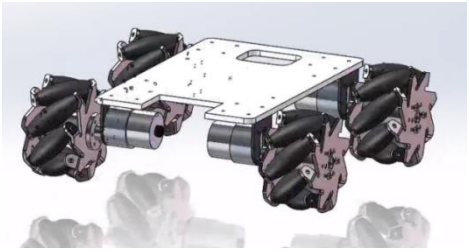

Figure 4: Chassis structure

The end actuator can complete 0°to 120° opening and closing. The chassis is driven by wheat wheel, and the fixed rotation Angle of the carrier and the fixed advance distance are completed by cascade PID.The chassis can move in all directions, and the coordinate system can be established at the cross points of the black lines on the whole map through the algorithm. The carrier can record its position information when it moves on the X-Y axis. In order to simplify the path planning algorithm, the carrier always moves forward and to the right.

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3. Control Plan

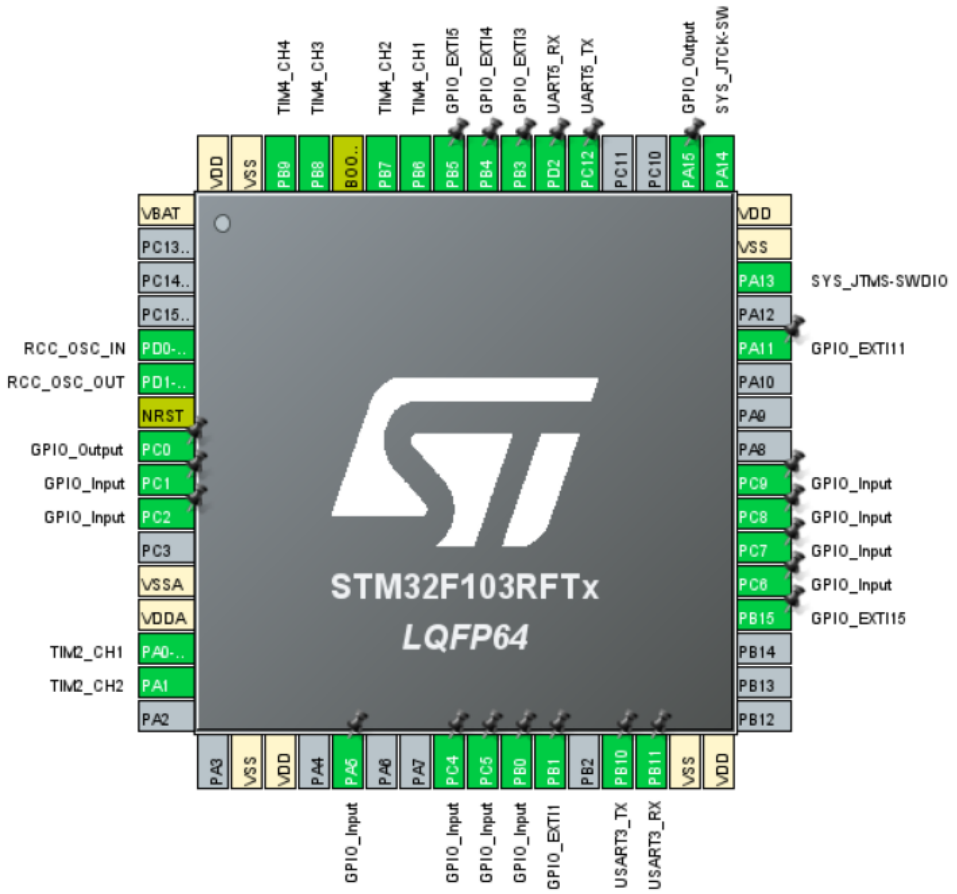

Figure 5: STM32F103

STM32F103 is used as the core control board, the encoder mode of timer 2 and timer 4 is used to obtain the motor speed, the gray sensor signal identification black line is obtained by using eight GPIO, and the task information and feedback value of the WiFi module are obtained through the transmission and reception of serial port 3.

```
/*Goal: Read high and low level four together to distinguish 1FB/2FB*/
int read_pin_GO_QianHou_X(void)
{
    EXTI_Disable(1);// Close the trunk 1
    EXTI_Disable(15);// Close the line where interrupt 15 is located


    Pin_10=HAL_GPIO_ReadPin (GPIOB,GPIO_PIN_15);// Left front
    Pin_11=HAL_GPIO_ReadPin (GPIOB,GPIO_PIN_0);// Right front
    Pin_12=HAL_GPIO_ReadPin (GPIOC,GPIO_PIN_5);// Left back
    Pin_13=HAL_GPIO_ReadPin (GPIOC,GPIO_PIN_1);//Right back
    Pin_1=Pin_10*1000+Pin_11*100+Pin_12*10+Pin_13; //Z

    return Pin_1;
}
```

Figure 6: Grayscale sensor parameter

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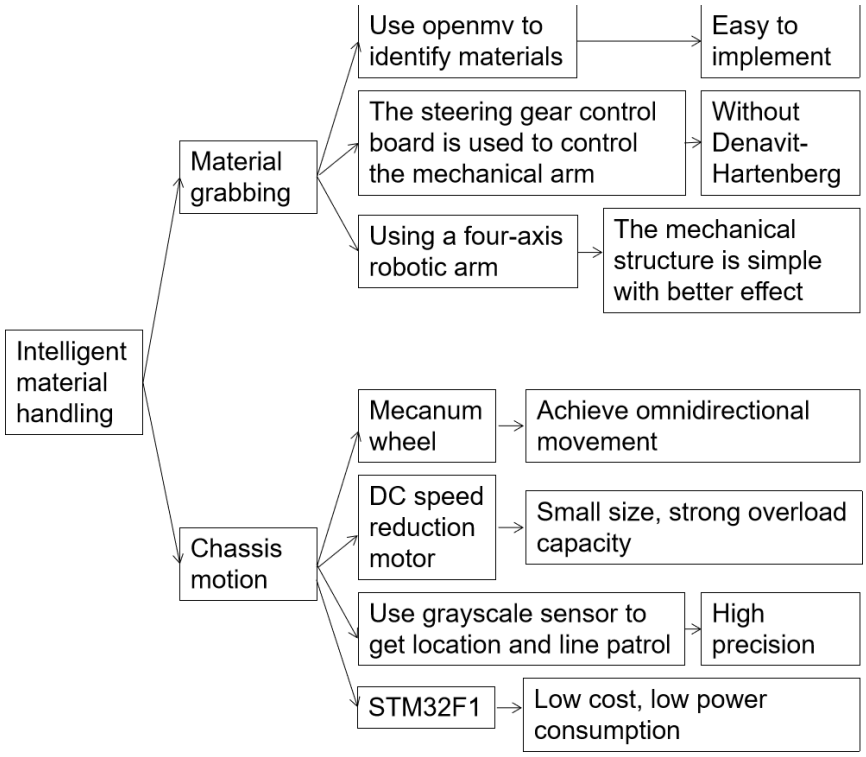

Figure 7: Mentality of designing

Path planning is the control signal obtained by combining the eight logical numbers composed of 0 and 1 obtained by the gray scale sensor and comparing with the original data table at the STM32 end. When the received 8-bit data shows that only the four gray channels on the central axis are displayed as black, it indicates that the truck has no offset motion track. When the obtained 8-bit data is not symmetric, it indicates that the center trajectory has been shifted.

```
void drive_control(void)
{
  EXTI_Enable(1);  //Open interrupt 1 (interrupts used in line counting: Open)
    EXTI_Enable(14); // Open interrupt 14 (interrupts used in line counting: Open)
    current_y=Count_Y;  //interrupt
    current_x=Count_X;  //interrupt
    y=target [0];
    x=target [1];
    Y=y-current_y;//Y-axis direction: Target value - current value (direction of movement along the Y-axis)
    if(Y<0)
    {
        move_direction=4;       //Shift left
        Mai_four_direction_run();
    }
    else if(Y>0)
    {
        move_direction=2;    //Shift right
        Mai_four_direction_run();
    }
    else  //The difference in Y = 0
    {
        move_direction=0;     //STOP
        Mai_four_direction_run();
    }

    X=x-current_x; //X-axis direction: Target value - current value (direction of movement along the X-axis)
    if(X<0)
    {
        move_direction=3;
        Mai_four_direction_run();// Move back
    }
    else if(X>0)
    {
        move_direction=1;
        Mai_four_direction_run();// Move forward
    }
    else   //The difference in X = 0
    {
        move_direction=0;
        Mai_four_direction_run(); //STOP
    }
}
```

Figure 8: Code and logical functions

ISSN: 2664-9640

4. Test

The color identification of materials is completed by using openmv, the serial port characteristic protocol is written, the task information obtained by WiFi is stored, the target is identified, and then the data interaction between openmv and STM32F1 is completed through the serial port.

Table 1: Task completion record

	Red material	Green material	Blue material	Yellow material
Zone 1	√	√	√	×
Zone 2	√	×	√	√
Zone 3	×	√	√	√
Zone 4	√	√	√	√
Zone 5	√	√	×	√

As shown in the table, the work was carried out according to the task information sent by the WiFi module. In the course of four operations, materials of four different colors were put into different areas numbered 1-5 respectively, and one area was free each time. As can be seen from the experimental data, the assigned task was completed with good effect and high accuracy.

Figure 9: Openmv Color recognition

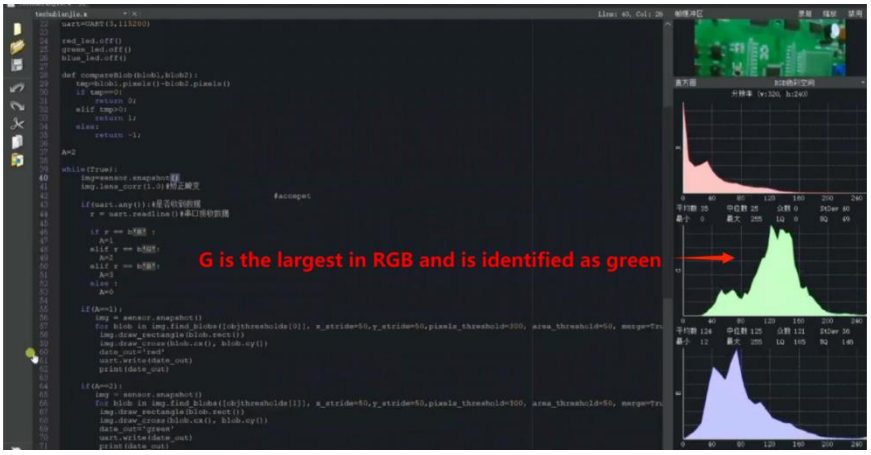

Figure 10: Openmv Color recognition

5. Conclusion

By combining the STM32F1 main control board, Openmv, grayscale sensor, WiFi module, the wheel chassis, the pith robot arm and the end actuator, the path planning, tracking and handling

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of the specified materials are completed in the specified time. Through the test, the effect is good, the use of automatic way instead of manpower, saving handling costs, high reliability, high accuracy.

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