

Control System Design of Remote-controlled Floating Garbage Cleaning Robot Suitable for Small Water Area

Wencheng Wang^{1,2,*}, Pengcheng Zhang^{1,2}, Jinshuo Zhang¹, Tianci Liu¹

¹*Department of Mechanical Engineering, Hebei University of Water Resources and Electric Engineering, Changzhou, 061000, China*

²*Hebei Industrial Manipulator Control and Reliability Technology Innovation Center, Changzhou, 061000, China*

**Corresponding author*

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Abstract: The ubiquitous garbage pollution in lakes, wetlands and rivers has become an urgent problem to be solved. With Arduino as the core, this paper has completed the function design, circuit design and program design. The control system of small water garbage cleaning robot is designed, and the whole remote control module is divided into control module, rocker module and wireless module. The control part uses Arduino Nano series microprocessor. On this basis, the signal is transmitted and received, and transmitted to the receiving module of the garbage collector to complete the control of the robot. Use NRF24L01 wireless module for remote control.

1. Introduction

In recent years, the garbage pollution on the water surface of domestic lakes and urban rivers has become more and more serious, which has seriously affected the ecological balance of waters. Parks and other playground lakes, ponds on the water surface often have leaves, plastic bags, floating bodies and other surface garbage, affecting the landscape, pollution of the environment. At present, there are various surface garbage cleaning vessels on the market, which are generally driven by fuel oil, and have air pollution, noise pollution and oil pollution problems, and are large in volume, which is not suitable for small water surface garbage cleaning work. In addition, most of the garbage cleaning of lakes and urban rivers is in the form of manual salvage by manually driving boats, which has high labor intensity, low work efficiency, long cycle and insecurity. This method often uses a lot of manpower and material resources, but the effect is not obvious. In order to solve the above problems, this paper designs the control system of the surface garbage cleaning robot suitable for lakes, ponds and urban river channels[1].

2. Structure of garbage cleaning robot

The new small water garbage cleaning robot is a new high-tech environmental protection product, mainly used for the salvage and collection of floating objects on the water surface (such as floating

garbage), with a high degree of automation, and can basically complete the collection of all kinds of floating garbage on the water surface. The structural diagram is shown in Figure 1. Where 1 is the hull, 2 is the hull connection device, 3 is the pushing device, 4 is the bow, and 5 is the cleaner.

The garbage cleaning robot should move in eight directions: front, back, left, right, left front, right front, left back and right back. The collector should be able to rotate and collect heavy floating waste into its interior. According to the characteristics of the robot, the direction is controlled by two DC motors, and the propeller rotation direction of the hull propulsion structure is controlled by the positive and negative rotation of the motor.

When the robot travels too far, the user cannot clearly see the location of the garbage, and the display device is needed. The display device is composed of a camera and a display screen. The real-time water condition is recorded by the camera at the front end of the robot, and transmitted to the display screen on the remote control through the image transmission module, so that the user can see the location of the garbage more intuitively and facilitate operation. The display device is shown in Figure 2.

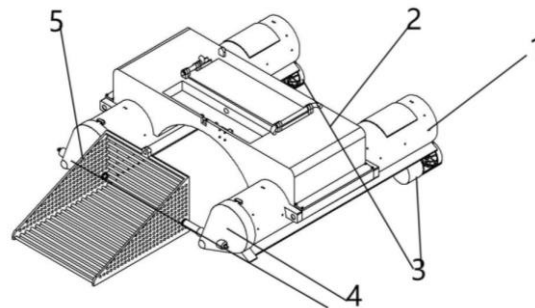


Figure 1: Structural of heavy floating garbage collection robot



Figure 2: Display device

3. Overall function design of remote controller

The remote control device designed in this paper can remotely control the garbage cleaning robot, use the buttons and rocker on the remote control panel to control the status of the garbage cleaning robot, and set its parameters and status. The decomposition of the remote control function is shown in Figure 3

register; Defines screen plug, wireless transceiver, input/output port, data, flag bit, ROM memory, display, key, hardware structure, wireless communication, receiver Settings, PWM, automatic control, switching, channel operation, curve operation, delay function, ROM operation function, data read/write control, etc. The flowchart of the Remote program flow chart is shown in Figure 5.

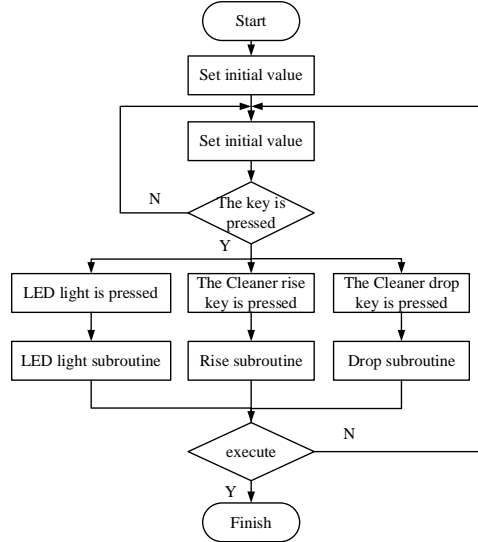


Figure 5: Remote program flow chart

5.1.1 Wireless program Setting

NRF24L01 model wireless module is used, and the program calls NRF24L01 function data from SPI program library. Debug password and baud rate of wireless module with serial port applet. The baud rate is 9600. The 7 and 8 ports of Arduino are connected to the CE and CSN of the wireless module respectively for data transmission. The procedure is as follows:

```

#include <SPI.h>
#include <nRF24L01.h>
#include <RF24.h> //Wireless definition
const uint64_t pipeout = 0x000000; //Correspondence address
RF24 radio(7,8); //CE,CSN;
const byte address[][6] = {"00001", "00002"}; //Data definition
  
```

5.1.2 Pin setting

According to the direction required by the boat, the speed size, the lifting of the cleaner, the brightness of the LED light and the power display, some pins of the MCU are set. The lifting of cleaner uses 3 and 2 serial ports respectively to output data, LED lights use 0 serial ports, and the rocker that controls the direction uses A0 and A1 to output data. Power display four LED lights with 4, 5, 6 serial ports.

```

int dian;
bool a=1;
struct Signal
{
  bool sheng;
  bool jiang;
  bool led;
  int x;
  int y;
}
  
```

```

};
pinMode(2,INPUT_PULLUP);
pinMode(3,INPUT_PULLUP);
pinMode(0,INPUT_PULLUP);
pinMode(A0,INPUT);
pinMode(A1,INPUT);
pinMode (4,OUTPUT);
pinMode (5,OUTPUT);
pinMode (6,OUTPUT);
}

```

5.1.3 Working mode of the rocker module

The working mode of the rocker module is: the mode electric pin input reads the digital amount of 0 to 1023, which is used to read external data, and the control motor uses the wave of PWM frequency 0 to 255, 255 is changed to the duty cycle, 255 is all the high point, and the output is used to control the motor speed.

```

data.x=map (analogRead(A0),0,1023,0,255);
data.y=map (analogRead(A1),0,1023,0,255);

```

5.2 Receiver control program

When designing the receiver program, the program should be designed according to the function and hardware that the robot needs to achieve. The receiver uses a 6DB enhanced antenna and the receiver can receive up to 2000 meters.

The need for early definition includes: define the register, define the pin, define the indicator light, define the pin of the wireless module, data storage, wireless communication, channel output, voltage detection, delay function, ROM storage, NRF24L01 compilation, serial communication.

After compiling the program, search for the receiver on the remote control. When the receiver successfully pairs the frequency with the remote control, it will show that the communication is successful. The program flow chart of the receiver is shown in Figure 6.

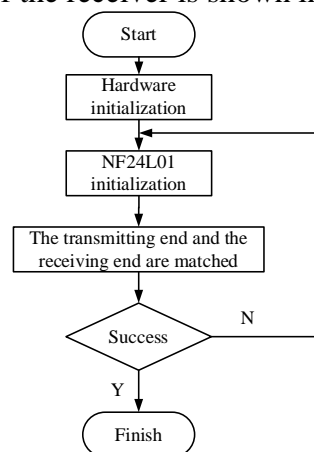


Figure 6: Receiver program flow chart

5.2.1 Initialize definition

The hardware is initialized with x and y variables between 0 and 255, so its initial value is set to the middle value of 126, indicating that the garbage ship is at rest. LED light and heavy collector lift

We set the initial value to 1.

```
data.x = 126;
data.y = 126;
data.led = 1;
data.sheng = 1;
data.jiang = 1;
}
```

5.2.2 Pin setting

Due to the two-body structure of the robot and the various functions of the garbage cleaning robot, a total of three motors and one LED light are needed, and each motor needs two ports. The left motor of the robot uses the 3 and 9 ports of the Arduino microcontroller to control the positive and negative rotation of the motor. The right side uses ports 10 and 11; The lifting of robot cleaner is realized by the positive and negative rotation of the intermediate motor, using 5 and 6 two ports; LED lights use 2 ports. In most Arduino microcontroller 3, 9, 10, 11 four ports can be PWM output, easy to speed. So the two traveling motors are placed on these four ports. The digital pin call defines the input and output, so the output of the lamp needs to be defined by the program[4-5].

```
pinMode (0,OUTPUT);
pinMode (1,OUTPUT);
pinMode (2,OUTPUT);
pinMode(A0,INPUT);
```

5.2.3 Cleaner control program

The rise and fall of cleaner is divided into two button control, when the cleaner needs to rise up, give it a signal 0 input, then 2 port output high level, 10 port output low level, so that the motor is turning, similarly, the fall of cleaner is the same. If no input signal is received, the initial state is maintained, and ports 10 and 2 are low. The motor is stationary.

```
if (data.sheng==0)
    {digitalWrite(2,HIGH);
    digitalWrite(10,LOW);
    }
else if (data.jiang==0)
    {digitalWrite(10,HIGH);
    digitalWrite(2,LOW);
    }
else
    {digitalWrite(10,LOW);
    digitalWrite(2,LOW);
    }
```

5.2.4 Travel program

The garbage cleaning robot needs to realize the function of eight directions, respectively, positive front, positive back, positive left, positive right, left front, left back, right front, right back. Take the right back as an example: when the outside world pushes the joystick, it changes the PWM values of x and y. When both x and y accept values greater than 170, the 3-port output value is 20, the 9-port value is 150, the left motor is reversed, and the 5 and 6 ports both output value 20. Right motor does not rotate. That's why I'm turning right down. The rest of the direction principle is the same as the lower right.

```

a=(data.y)>125?(data.y-125):(125-data.y);
//Serial.print(a);Serial.print("\t");
if (data.x>=170)
    {if (data.y>=170)
        {analogWrite(5,20);
          analogWrite(6,20);
          analogWrite(3,20);
          analogWrite(9,150);
        }
    }

```

6. Conclusions and Discussion

In the research of the garbage cleaning robot control system, With Arduino as the core, this paper has completed the function design, circuit design and program design. The control system of small water garbage cleaning robot is designed, and the whole remote control module is divided into control module, rocker module and wireless module. The control part uses Arduino Nano series microprocessor. On this basis, the signal is transmitted and received, and transmitted to the receiving module of the garbage collector to complete the control of the robot. Use NRF24L01 wireless module for remote control.

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