

Intelligent robot for glass cleaning at high altitude based on rotating shaft connection and stm32 control

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Abstract: At present, there are few high-altitude glass cleaning equipment on the market that can cross obstacles, usually requiring manual transfer. Even with intelligent obstacle avoidance system, it is still difficult to climb over the floor, the frame between the glass and so on. The automation of the project is low. To solve the above problems, the glass cleaning robot designed in this paper can autonomic obstacle avoidance transfer through the stm32f407 core control board, and Raspberry PI to jointly complete the obstacle avoidance, navigation, movement and other control tasks. And the use of a new mechanical structure, through the quadcopter wing folding contraction, to complete the process of wiping glass push and pull. During the transition from flight to climbing, horizontal to vertical changes are achieved by folding the fuselage. Through many experiments, the design is reliable and practical.

Keywords: High altitude; Operation quadcopter; Deep learning; Rotary shaft vehicle.

1. Introduction

At present, whether the glass cleaning equipment used in the family or the glass cleaning machine used in the building, most of them are low in intelligence and cannot be controlled in real time, or there are many places using artificial aerial work to complete the glass cleaning, which is very dangerous.[1-4] After observing this problem, this paper designs a quadcopter which can move autonomously, jump over obstacles, and switch between crawling and flying modes automatically. Reduce production cost through innovative mechanical design, with practicability and reliability.

2. Design idea

2.1. Control part

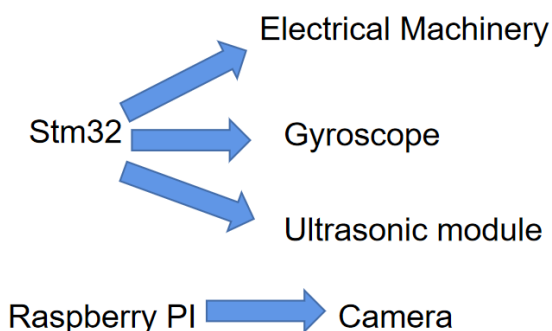


Figure 1. Overall control idea

The bottom drive of the quadcopter is completed through the control of gyroscope and motor carried by Stm32 microcontroller. Obstacle avoidance is carried out by ultrasonic module.

2.2. Mechanical part

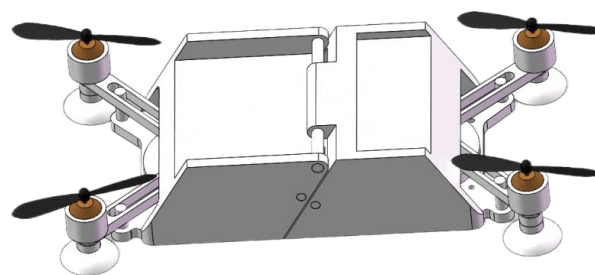


Figure 2. Flight attitude

Driven by motor, the aircraft can complete the flight state of the quadcopter and transfer different areas.

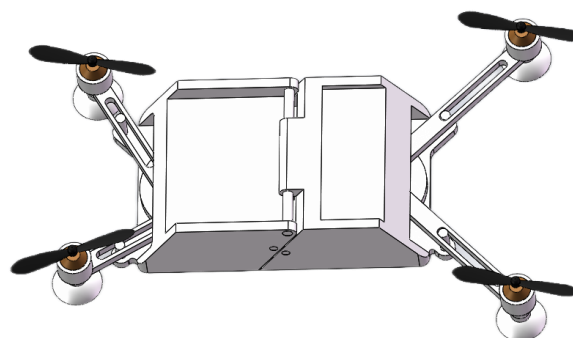


Figure 3. Climbing attitude

The four wings of the vehicle are connected to a central rotating bearing, which is controlled by a motor to achieve wing shrinkage. Making the aircraft work at high altitude is to complete the crawling state. One side fold and the other side stretches. To finish cleaning the glass. [5-6]

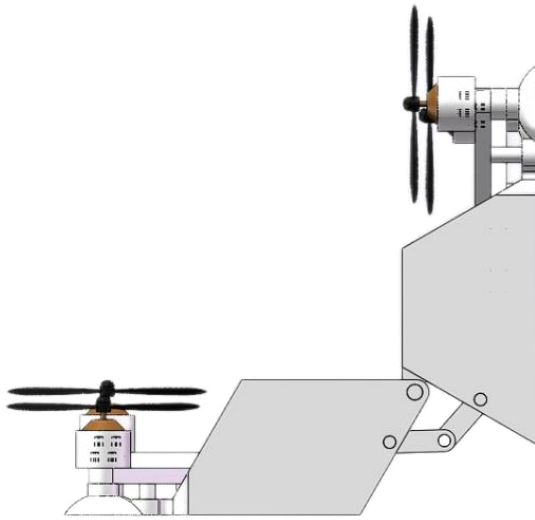


Figure 4. Folding attitude

There is a folding mechanism in the center of the two main mechanical structures, which is controlled by the motor, so that the mechanism can complete symmetrical folding, making the aircraft from the flight state to the folding state. After landing on the wall, you can finish high altitude work.

3. Control algorithm

3.1. Motor control

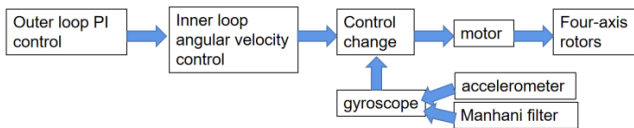


Figure 5. Cascade PID control flow chart

3.2. Visual algorithm

Of the hundreds of pictures by Yolov5m model training, get the weight files, compares the model parameters, in the practical obstacles in real-time pictures using camera, for each frame for identification.

4. Test

Table 1. Obstacle avoidance test

	advance	back
0.06m	√	√
0.13m	√	√
0.17m	√	√
0.22m	√	√
0.24m	√	√
0.37m	√	√

The test shows that the aircraft has a high accuracy in identifying obstacles. The test of obstacle crossing ability can be seen at different speeds have a good degree of completion.

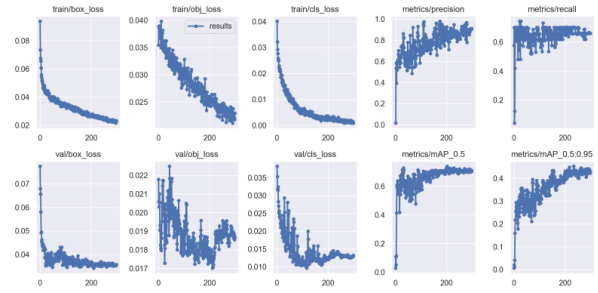


Figure 6. Yolov5 model parameters

Cleaning operations are based on visual identification of obstacles and stains. When working at altitude, the water yield and clear speed and time are controlled for different situations such as rain stains and dust, which makes the accuracy higher and the effect better.

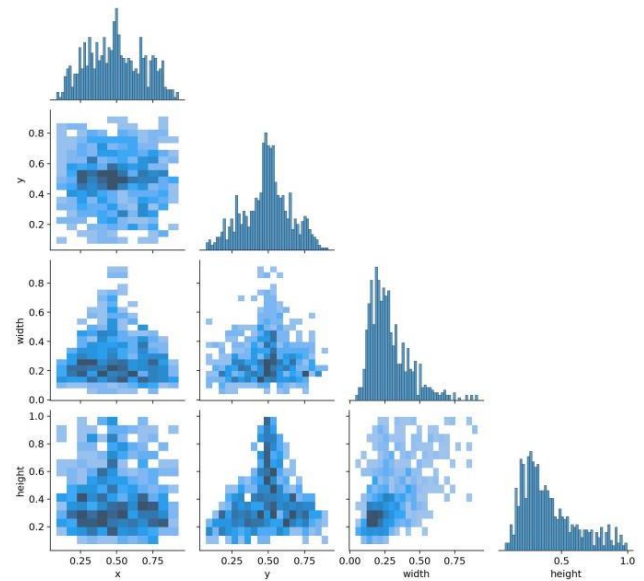


Figure 7. Yolov5 model parameters

5. Conclusion

Through the test, the aircraft can complete autonomous navigation and positioning, and when it comes into contact with the wall, it can autonomously shrink into a folding posture, and complete the contraction and extension of the four wings under the drive of the motor, so that the high-altitude glass can be scrubbed in the climbing state. The main body of the motor cascade pid control, Euler Angle calculation, gyro and serial data analysis. Innovation in mechanical structure. Deep learning adopts yolov5m model with high recognition accuracy.

References

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