Wall-climbing obstacle-avoiding full-automatic lampblack cleaning device

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Abstract. With the development of Chinese society and the progress of productive forces, dust and oil stains are easily produced in kitchens and ceilings when living at home. Dirt deposition in many places cannot be carried out well due to the limitation of space location and cleaning methods, which brings great inconvenience to people's life. At the same time, the existing cleaning robots in the market need to work on a single wall surface, and when encountering obstacles, the positions of the robots need to be adjusted manually to further realize the work and cannot solve the cleaning problems of ceilings and the like. The existing cleaning robots mostly use centrifugal fans to fix on vertical wall surfaces in an adsorption way, thus causing obstacles to be avoided, the connection between different wall surfaces cannot be realized, and the defect that intelligence works on a single wall surface requires manual wall surface replacement, thus reducing automation, intelligence and intelligence. Based on the above background, the members of this group have designed a wall-climbing cleaning machine. The device mainly comprises a walking module, a wall turnover module and a cleaning module [1].

1. Introduction
At present, the scope of most cleaning machines is mostly limited to window glass, which can not be widely applied, thus reducing its efficiency, and correspondingly can not significantly reduce the cleaning cost, which is not easy to popularize and has a poor market prospect. The invention improves the structure of cleaning machines on the market, thereby improving the application range and cleaning efficiency of the cleaning robot for wall cleaning, reducing the potential safety hazard of high-rise glass cleaning, reducing the cleaning cost, and having great significance and economic benefits.

2. Design
2.1 Research content and key technologies
1) The space four-link mechanism controlled by three highly precise steering gears can effectively realize the lateral movement of the range hood on the wall and complete the movement from one wall to the other. And if the recognition module around it recognizes the obstacle, it can complete the obstacle avoidance function by sending instructions to the steering gear [2].
3. Overall design

3.1 Functional design
1) The device can achieve smooth walking on vertical walls.
2) The device can realize the action from one wall to the other wall.
3) The device can effectively clean the oil stains on the wall.
4) The identification module around the device can realize the identification of obstacles and quickly judge whether the stain is clear so as to execute the next instruction.

![Figure 1 Overall schematic diagram of the device](image)

3.2 Structural design
1) Cleaning section
   - Vacuum water pump
   - Disc brush
   - Roller brush
   - Water tank with cleaning agent
   - High-speed motor

Because the oil fume is difficult to clean, in order to better clean the oil fume, we have designed a double cleaning mechanism as shown in the figure. First, the water pump sprays the cleaning liquid inside the water tank into a mist through the spray head and sprays it to the front of the cleaning module. The two front brush heads are driven by the motor to rotate at high speed for the first time cleaning. To clean the remaining cleaning liquid on the wall and the residue after cleaning [3].

![Figure 2 Cleaning part](image)
2) Walking section
In order to realize the transfer of the wall of the mechanism on different planes and the lateral movement on the vertical wall surface, we designed the wall-turning module, as shown in Figure 3. The mechanism is a space four-link linkage mechanism driven by three steering gears. The three steering gears control the forward and backward movement, vertical movement of the connecting rod, and the rotation of the end suction cup. Functions such as lateral movement, over the wall and obstacle avoidance.

![Figure 2 Walking obstacle-crossing module](image)

4. Feasibility analysis
We calculated our space four-linkage according to the calculation formula of the connecting rod in the book "Principle of Machinery and Mechanical Design", and concluded that the machine can take a step up to a stroke of 20cm [4]. The motion path and force situation of the force components in the simulation are simulated, and it is found that the design can achieve our intended purpose. We also used ANSYS FLUENT to perform fluid mechanics simulation of the air pump and suction cup, and concluded that the mutual operation of the suction cup and the air pump can meet our requirements [5].

5. Innovation
1) New structure and ingenious design: Two different adsorption and movement devices are combined, and the suction and release of a plurality of vacuum washing plates are matched with each other, so that the movement is more flexible.

2) Multifunctional and efficient work: The device integrates a cleaning function, a wall climbing function and a barrier surmounting function, and simultaneously combines an ultrasonic detection system, so that the device can complete various motions according to actual environmental requirements, and the purpose of completely cleaning a predetermined area is achieved [3].

6. Conclusion
The project team has designed a wall climbing device which can realize multiple functions such as wall climbing, obstacle avoidance, cleaning, etc. Based on the weakness of existing products, it has good market prospect and broad development space, and can better meet the needs of people's daily life.

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