Computer Life (CPL) ISSN: 1819-4818
DELIVERING QUALITY SCIENCE TO THE WORLD

Structural Design of tracked Rescue Robot

Tantan Li [a], Yapeng Zheng [b, *] and Peng Yang [c]

School of Shangdong university of Science and Technology, Qingdao 266590, China

[a]1327196992@qq.com, [b]735093200@qq.com, [c]1500541791@qq.com

---

Abstract: In modern life, robot plays a more and more important role. Especially in some adverse working conditions that cause harm to people. In this paper, the design requirements of the robot are put forward, the overall scheme of the design and the specific structure of each degree of freedom are designed, and the tracked walking mechanism is designed, and the reasonable design of the fuselage is carried out. The manipulator adopts four-joint manipulator with high degree of freedom and can grasp objects flexibly.
Keywords: tracked rescue robot; Structural design; Four-joint manipulator.

---

1. RESEARCH BACKGROUND

The complexity, danger and urgency of the disaster search and rescue work bring great difficulties to the rescue work. The rescue robot has the characteristics of good flexibility, strong mobility, and good ability to climb slope and surmount obstacles. It can adapt to all kinds of geographical environment of the scene, at the same time, it can find the position of the advance personnel quickly in the rescue process, and can detect all kinds of changes of the accident site to prevent the accident from happening again. Because the rescue robot can also overcome the low efficiency of the traditional rescue, the instability of the large equipment rescue, the flexibility and speed of rescue, the convenience of carrying, and the ability to adapt to the environment, so the rescue robot is studied. It is of great significance in the rescue work. As shown in the figure1.1.

Figure 1.1

2. CURRENT SITUATION OF RESEARCH ON TRACKED RESCUE ROBOT

Robot technology originated from battlefield reconnaissance, battlefield cleaning and so on in the military field. Before 1980s, some people began to discuss the application of robot in disaster search and rescue in theory.

In 1995, it was of great significance in the history of the development of rescue robot technology. The massive earthquake in Kobe-Osaka, Japan, and the explosion at the Alford Federal Building in Oklahoma, Oklahoma, opened the stage for research on rescue robotics.

The 9 / 11 incident in the United States in 2001 provided a valuable practical opportunity for the rescue robot, and the rescue robots of the American Robot Aid Rescue Center and some other units participated in the rescue operation. They are Foster-Miller 's SOLEM system, Tolon system, lnuklun's VGTV system and Microlac system. The robot has been successful in the rescue operation. At the same time, many problems have been exposed in the rescue, such as unreliable control, poor waterproofing, narrow vision and so on[1].

The successful application of robots in the 9 / 11 incident has triggered a boom in the research of rescue robots. In recent years, a large number of research results have been published, and great progress has been made in both theoretical and practical applications. A variety of rescue robot systems have been developed, and rich experience has been accumulated in practice.

At present, the research of rescue robot mainly includes four aspects: 1 motion control technology, 2 communication control technology, 3 autonomous navigation technology and 4 detection and perception technology.

3. DESIGN OF TRACKED RESCUE ROBOT

3.1 Overall design thinking

The design of robots can be broadly divided into two phases:

I. System analysis phase

1. According to the goal of the system, the purpose and task of the robot are defined.
2. Analyze the working environment of the robot system.
3. According to the requirements of the robot, the basic function and scheme of the robot are determined. For example, the degree of freedom of the robot, the amount of information stored, the function of the computer, the requirement of the precision of the action, the weight that can be grasped, the allowable range of motion, and the adaptability to the environment such as temperature, vibration and so on.

II. Technical design phase

1. Select the coordinate form of the robot according to the degree of freedom required by the system and the allowable space space working range
2, draw up the robot's movement route and space operation chart.
3. Determine the type of drive system.
4. Draw up the control principle diagram of the control system.
5, select a specific collective enough components, the robot assembly diagram design.
6, draw the robot part drawing, and determine the size.

The following combined with the basic requirements of the demo system and the basic principles of design to determine the scheme of the system.

3.2 Design process and characteristics

1.The robot must be small, flexible and easy to disassemble.

2.The structure of the robot can adapt to the change of different pipe diameter in the working process. The automation of C. robot is high and the control is convenient and flexible.

3.3 Design of walking mechanism of tracked rescue robot

Dimensions of tracked dimensions when steering, a tracked walking device needs to cut off the power of one track and brake the track so that it is stationary, steer by the push of the other track, or both tracks at the same time move one after the other and turn in situ, but the two steering modes require the same maximum driving force. So take machine single track brake to turn left to example, see figure 3.1.The track on the left is in the braking state. With the push of the right track, the whole machine rotates around the center C1 point of the left track, resulting in the steering resistance moment Mr2 and the walking resistance Fr/ 2 of the right track. .In general, the ratio of track grounding length L and track gauge B is L / B ≤ 1.6.At the same time, the L / B value also directly affects the steering resistance. Without affecting the stability of the machine and the specific earth pressure, the minimum value should be taken as far as possible, that is, the length of the track should be shortened as far as possible, which can reduce the driving force required by the walking mechanism[2].

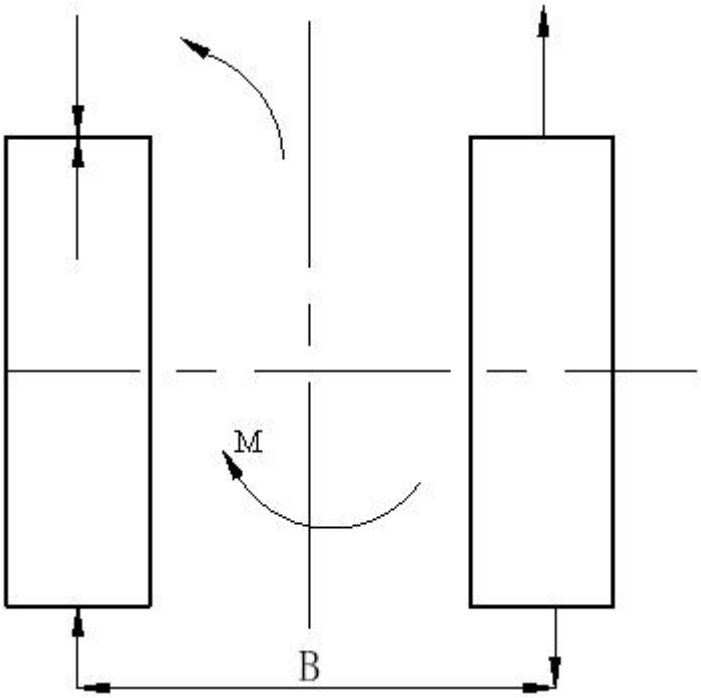

Figure 3.1

3.4 Overall mechanism design of tracked rescue robot

The tracked rescue robot includes a walking mechanism. The walking mechanism is a four-track structure, a motor, a connecting plate, a chassis, a manipulator with two degrees of freedom on the chassis, a wireless communication module, a material storage box, etc.The manipulator consists of a 360-degree rotating arm and a swinging arm, the end of which is a platform[3].As shown in the figure3.2.

The robot adds one degree of freedom to the end of the robot, that is, swinging joints and increasing its flexibility. The oscillating mechanism of the end actuator makes the horizontal workpiece grab and be placed in a vertical state. After the design of the tracked rescue robot mechanism, the technical parameters are: waist: 580mm, arm: 430mm, ±360 °(rotation angle), forearm: 410mm, ±150 °(swing angle).

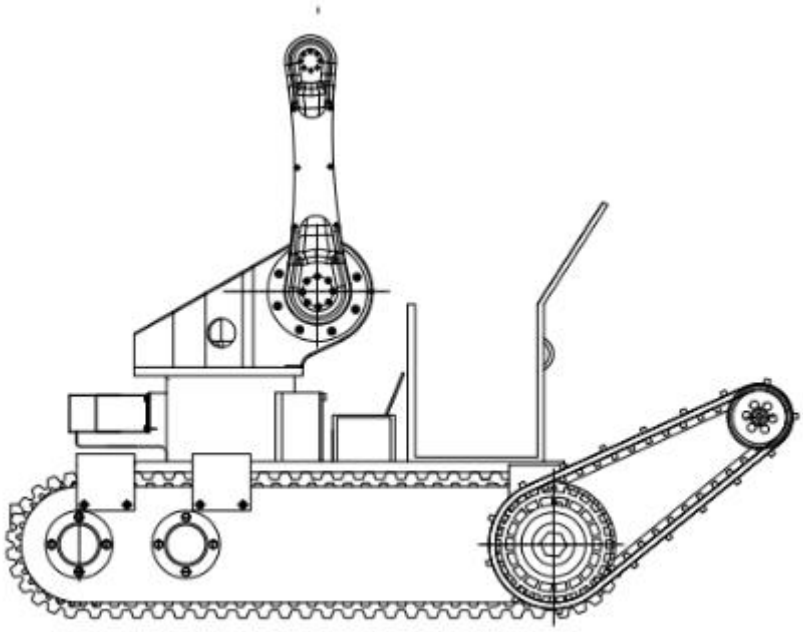

Figure 3.2

3.5 Structural requirements for manipulator

The arm part is the main component of the joint manipulator. Its role is to support the hands and drive them to do space motion. The purpose of arm movement: to send the hand to any point in space. If the posture (azimuth) of the hand is changed, the degree of freedom of the arm is realized. Thus, in general, the basic requirements for arm design are:

The arm should have large bearing capacity, good stiffness and light weight.

The arms are usually bent (not only in one direction, but also in torsion), so the section with higher bending and torsional stiffness should be chosen. Obviously, when the cross section area and unit weight are basically the same,

The moment of inertia of word steel and channel steel is much larger than that of round steel. Therefore, joint manipulators often use seamless steel tube as guide rod and I-beam or channel steel as support steel. This not only increases the stiffness of the arm, but also greatly reduces the weight

of the arm, and the hollow interior can also be equipped with a drive device. Actuators and pipes, so that the structure is compact, neat shape.

The speed of the movement of the arm is high and the inertia is small.

In general, the arm needs a uniform motion, but in the moment of starting and terminating the arm, the motion is changed. In order to reduce the impact, the acceleration of the starting time and the deceleration before the termination should not be too big, otherwise, the shock and vibration will be caused.

3.6 Working process of tracked rescue robot

When the tracked rescue robot finds the victim, it can transmit the scene to the rescuer in real time through the camera. Through the wireless communication module, the rescuer can communicate with the victim in a timely manner. The most reasonable advice is given according to the feedback from the robot and the victims. In addition, the storage box of the robot contains necessary medical items, survival items and so on. Through the support of these materials, the survival probability of the victims can be maximized before the rescue workers arrive.

4. SUMMARY

The application of the tracked - type rescue robot in the future life will be more and more widely . The application in the military field will be the inevitable trend of development and one of the directions of the key support of our national defense science and technology industry . Through the design of the mechanical arm system of the manipulator , a comparatively rich design experience has been accumulated in all aspects of the whole system , and it is believed that the continuous development and the improvement of the mechanical hand will be mature and practical .

REFERENCES

[1] Hongjun Liu. Approaching robot.Jilin people's Publishing House,2010, p.125-128.

[2] Aiping Xu. Introduction to Intelligent Robot production.People's Post and Telecommunications Publishing House,2001, p.155-168.

[3] Yunwen Li. Industrial manipulator design.Mechanical industry publishing house,1996, p.25-58.