

# Multi-degree-of-freedom Manipulator Driven by Micro Hydraulic System

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**Keywords:** Hydraulic system; Manipulator; Multiple degrees of freedom; Underwater operation; robot

**Abstract.** Now on the market are used motor-driven robot, so the ultimate environment (such as underwater) and cannot successfully complete the operation, and the use of micro-hydraulic system can effectively improve the torque, and can better be used in harsh environments. Using a fuel tank as the power source, the tank is connected to a hydraulic pump for pressure regulation. To control the rotation angle of the manipulator and the swinging of the forearm, three telescopic tubing are installed and three servos are installed at the rear. Machine control two oil. Assemble the encoder to record the location of the claw, after the completion of a move can be back to the original location. The manipulator can carry out the following operations: the handling of heavy objects, the center of the back 180 ° in front of heavy objects within the grasping, handling, through the LCD screen option, you can choose to move the location, angle and distance , Can better achieve the fixed point of heavy objects handling and handling. Micro-hydraulic system has the advantages of flexible control, large torque inertia and so on, and the manipulator can adapt to underwater operation, can replace the manual operation.

## Introduction

Robotics is an emerging interdisciplinary and integrated high-tech, is a combination of multiple disciplines of knowledge and cross. The kinematics and dynamics of mobile manipulators has always been an important branch of robotics. With the development of China's petrochemical industry, various types of chemical reaction vessels and pipeline leak detection and maintenance has become the petrochemical industry to be solved key technologies. Due to the dangers of leaking chemicals, mobile robots with autonomous capabilities are the replacement for the highly risky remediation of mankind. At the same time, mobile robots in the demolition of explosive, flammable materials, as well as explosion-proof, anti-terrorism and other social and public safety and military also has a wide range of applications. Fig. 1 is a widely used industrial robot manipulator picture.



Figure 1. Robot used in industry

However, because the current market mainstream robot are motor-driven, so in extreme circumstances (such as underwater) and cannot successfully complete the operation, so we consider the use of micro-hydraulic system drive, micro-hydraulic system with its flexible control, torque inertia. And other advantages, so that in the heavy machinery, engineering machinery, metallurgical

machinery and other fields has been widely used. The use of micro-hydraulic system instead of motor control can effectively improve the torque, and can better be used in harsh environments.

Our result is divided into mechanical design and control of two parts, in the back of the work there is a fuel tank as a power source, the tank connected to a hydraulic pump for oil pressure to control the rotation angle of the manipulator and the forearm swing up and down, Of the installation of three retractable tubing in the rear were installed three steering gear, each steering gear control two oil, the two corresponding to the front of the oil pipeline, one for oil, the other is carried out Back to the oil, but fortunately we installed a record of the location of the claw claw, after the completion of a move in time to return to their original location.

The following operations can be performed: Point-to-point handling of heavy objects can be carried out with the rear part as the center. The position, angle and distance of the objects can be selected by the options on the LCD screen. Can better achieve the fixed point of heavy objects handling and handling. The physical map of the work shown in Fig. 2.



Figure 2. physical hand figure

## Entire Introduction

**Entire Structure and Insulated Coat Introduction.** The micro-hydraulic system-driven mechanical arm we designed consists of two systems, one mechanical system, including: front paw, rack, arm, hydraulic cylinder, pump, mini hydraulic station. By the micro-hydraulic station to provide power, the oil pump to provide the hydraulic oil pressure to control the hydraulic cylinder through the telescopic arm to control the movement of the front paws through the steering gear to control the angle of opening, the crawling of heavy objects.

Control system mainly has a STM32 single-chip control, the main connection of four steering gear, of which three steering gear control of the three hydraulic cylinder to the oil and the oil, the other is to control the steering gear front open and closed, To control the crawl of heavy objects, through the control of the hydraulic cylinder to the oil and oil we can control the arm movement and rotation, to achieve the goods fixed-point handling.

**Gripper.** Robot Gripper is a robot part that can realize the human hand function. It is one of the important actuators for holding work pieces or tools. It is both a sensor and final actuator for active sensing of the working environment information. It is also a highly integrated Sensing, and intelligent electromechanical systems. It is involved in many research fields, such as mechanism, bionics, automatic control, sensor technology, computer technology, microelectronics technology and materials science.

As the hydraulic system can provide greater torque, so we use two fingers to move the design and production.

The gripper is a clamping type, the fingers of the gripper are driven by the double screw drive, dual guide and reinforcement guide, rail and screw axis line in the same plane, fingers only when the object in the uni-axial direction. Do the translation, the motor through the gear drive to drive the rotation of the double screw to the screw, finger gripper finger screw and screw through the connection and dual-guided role of the guide will turn into translational movement to achieve the two fingers open Close, and grab objects.

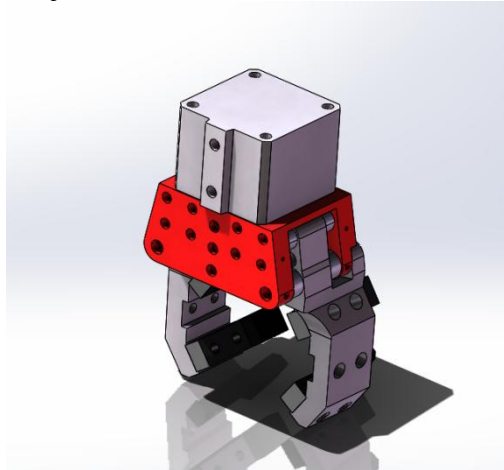


Figure 4. The gripper

**Arm.** Robot arm part of the implementation of pneumatic cylinder to do horizontal and vertical direction of motion control, by the pneumatic cylinder and motor and other components, generally from 4-6 degrees of freedom, the more advanced there are more degrees of freedom of the robot. Hydraulic drive is mainly used for heavy industrial equipment, which features high pressure, small size, large and smooth output. Cost and need to be equipped with a higher pressure source, the more complex lock. Therefore, the comprehensive comparison of our research is currently in the food machinery, medicine and other widely used potential of pneumatic manipulator control.

Arm assembly is divided into upper arm combination and lower arm combination. The combination of the upper arm and the upper case is connected with the arm elevating motor and the arm straightening motor driving the combination of the upper case. Upper arm internal through the belt drive, arm stretch motor running, the upper arm through the inner belt to complete the first layer of arm and layer 2 of the stretch action.

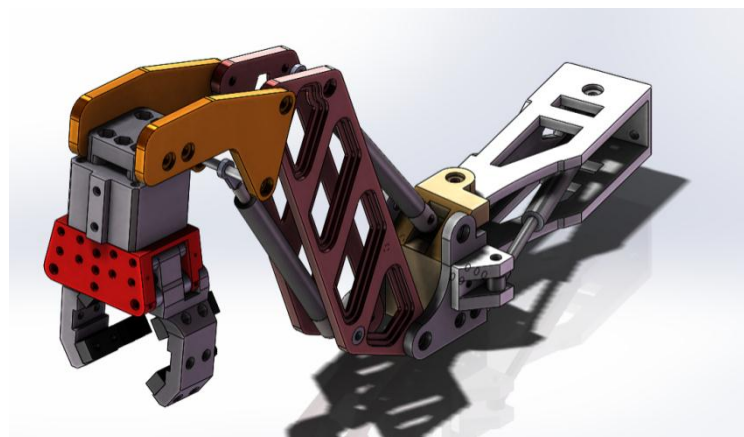


Figure 5. The entire design

**Features.** The multi-degree-of-freedom manipulator we developed with the miniature hydraulic system can perform the following operations: Point-to-point handling of heavy objects, which can crawl and transport heavy objects in the front 180 in the rear center, through liquid crystal display

On-screen options, you can choose the location of transport, angle and distance, to achieve a good point of heavy objects crawling and handling.

## Conclusion

Robotics is a new interdisciplinary integrated high-tech, is a combination of multiple disciplines of knowledge and cross. The kinematics and dynamics of mobile manipulators has always been an important branch of robotics. With the ability of autonomous mobile robot as a substitute for the completion of a high degree of risk to human repair operation of the best choice. At the same time, mobile robots in the demolition of explosive, flammable materials, as well as explosion-proof, anti-terrorism and other social and public safety and military also has a wide range of applications. However, because the current market mainstream robot are motor-driven, so in extreme circumstances (such as underwater) and cannot successfully complete the operation, so we consider the use of micro-hydraulic system drive, micro-hydraulic system with its flexible control, torque inertia And other advantages, so that in the heavy machinery, engineering machinery, metallurgical machinery and other fields has been widely used. Micro-hydraulic system instead of motor control can effectively improve the torque, and can better be used in harsh environments. We developed a multi-DOF manipulator which can be applied to underwater operation, instead of manual, significant savings in manpower and resources, and the relatively low cost, mass production, widely used in production and life.

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