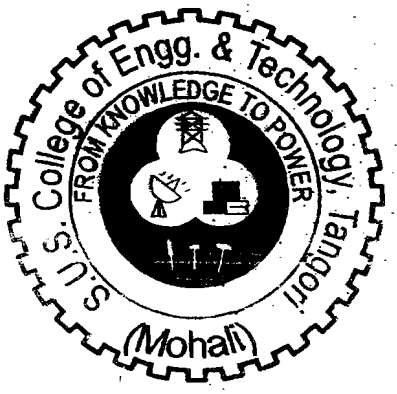
Proceedings of the

International Conference on Recent Developments in Mechanical Engineering

23 - 25 January 2008



Department of Mechanical Engineering

Shaheed Udham Singh College of Engineering & Technology

Tangori, (Mohali) India - 140 306

www.suscet.ac.in

ANALYSIS OF ROBOTIC GRIPEER SYSTEM

R.S.Gajre [1], A.C.Suthar [2], P.A.Patel [3]
[1] P.G.Student, Department of E & C, Nirma University, Gujarat, rakesggajre@gmail.com
[2] Asst.Prof, Department of E. &.C, C. U. Shah College of Engg. & Tech.,
Wadhwan City-363030, Gujarat, acsuthar@yahoo.co.in
[3] P.G.Student, Department of Mechanical Engg., C. U. Shah College of Engg. & Tech..
Wadhwan City-363030. pinank_ccet@rediffmail.com

Abstract

This paper analysis the working of a gripper, its uses and its application. The ability to handle objects is a trait that has enabled humans to manipulate the environment. Without our arms and hands, we would not be able to do our work. It makes sense, then, to provide arms and hands to our robot creations so they can manipulate objects and use tools. Robot arms are commonly referred to as grippers or end effectors. A robotic gripper is used to move a light weight object from one location to another. Robotic grippers come in a variety of styles. Here it is constructed using aluminium and standard servo. The gripper can be controlled using a radio receiver.

Key Words: Grippers, Pivoting movements, Linear Movements, Controlled movements.

1. Introduction

It uses the concept of parallel linkages to keep the fingers parallel throughout the horizontal motion. Here the rotary motion of the servo is converted into linear motion by making use of mechanical linkages[1],[2]. This prevents the use of gears.

2. Basic Theory of Gripeer

Grippers are end effectors used to grasp and hold objects. These objects are generally work parts that are to be moved by the robot which include machine loading and unloading, picking parts from a conveyer, and arranging parts onto a pallet.

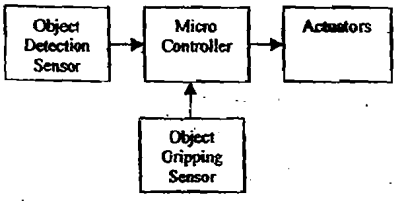


Figure 1. Basic Block diagram of gripper

Object Detection Sensor: This is used for detecting the object.
Object Gripping Sensor: This is used for grabbing the object.
Microcontroller: This is used to receive the signals from both, object detecting sensor and object gripping sensor and control the actuator accordingly.
Actuators: This receives the signals from the microcontroller and grabs the required object.

3. Mechanical Gripper

A mechanical gripper can be defined as an end effecter that uses mechanical fingers actuated by a mechanism to grasp an object. The fingers, sometimes called jaws, are the appendages of the gripper that actually make contact with the object [3]. The fingers are either attached to the mechanism or are an integral part of the mechanism. The function of the gripper mechanism is to translate some form of power input into grasping action of the fingers against the part [8]. The power input is supplied from the robot and can be pneumatic, electric, mechanical, or hydraulic.

4. Analysis of Gripper

If a force of sufficient magnitude is applied against the part in the direction parallel to the friction surfaces, the part may slip out of the gripper [4],[5]. To resist this slippage certain parameters should be taken in to account. The weight of the part (w), the coefficient of friction between the part surface and the finger surface (m), the acceleration, the force (Fg) and the number of finger

$$Wg=m\ n\ Fg$$

The general equation used to make the parallel gripper is Force on the gripper = Force on the linkages

$$Fg\ (2\ \cos A + 1.5\ \cos B + 2\ ¼\ \cos C) = \{0.5\cos\alpha\ F\ \sin\beta + .5\sin\alpha\ F\ \cos\beta\} - \{(7/8)\ \cos\mu\ F\ \sin\gamma + (7/8)\ \sin\mu\ F\ \cos\gamma\} + \{(1/2)\ \cos\lambda\ F\ \sin\varphi + (1/2)\ \sin\lambda\ F\ \cos\varphi\}$$

Where;
A, B, C represents the angles formed by the gripper and α, β, μ, γ, λ, φ represents the angles formed by the linkages
Substituting the given variables with value into the formulated equation:
A=0, B=0, C=0, α=0, β=90, μ=45, γ=135, λ=45, φ=135 and also;

cos0 =1	cos45=0.707106
sin0 =0	sin45=0.707106
cos90=0	cos135=-0.707106
sin90=1	sin135=0.707106

We get:

$$Fg = (1/48)\,F$$

Where:
Fg: represents the force on the gripper
F: represents the force applied on the linkages

5. Types of Gripper Mechanism

1) Pivoting Movement:
Here the fingers rotate on fixed points to open and close the gripper.
2) Linear movement:
Here the fingers open and close by moving in parallel to each other.
Here the pivoting mechanism will be taken into study [6]. A diagram below is giving a basic idea about the mechanism used.

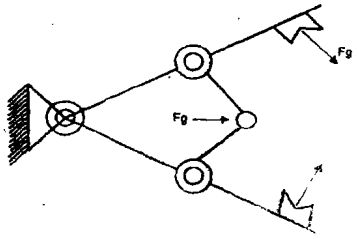


Figure 2. Diagram of movement of arm

6. Description of required materials

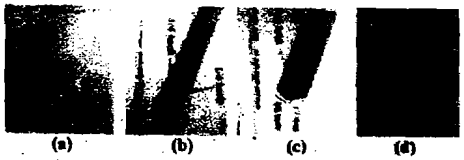


Figure 3. (a) 1/2 " x 1/8" Aluminum Stock (b) 1/2 " x 1/8" Aluminum Stock (c) 1/2 " x 1/2" x 1/16" Angle Aluminum (d) 1/16 " Thick Flat Aluminum

The required aluminum materials are obtained and these materials are cut according to the requirement. The table indicates a clear view about the size required.

Figure 4. (a) Base (b) Gripper Fingers (c) Grippers

Part	Quantity	Description
Standard servo	1 nos	Servo , horn and screw
1/16" thick aluminium	10" X 3"	Aluminium stock
1/4" X 1/4" aluminium	25 "	Aluminium stock
1/2" X 1/8" aluminium	2 "	Aluminium stock
1" length machine screw	4 nos	6/32 diameter
3/4" length machine screw	7 nos	6/32 diameter
1/2" length machine screw	6 nos	6/32 diameter
6/32 nylon washer	14 nos	nylon washer
6/32 diameter lock nut	17 nos	locking nut

Table 1. Clear view of required material with size.

Figure 5. Required components for preparing gripper

Figure 6. Complete structure of Gripper

7. Working of grippers

In theory grippers are end effectors used to grasp and hold objects. The opening and closing of the gripper depends on the rotation of the servomotor. There is a potentiometer near the motor which helps in the 180° rotation both in the clockwise and anticlockwise direction

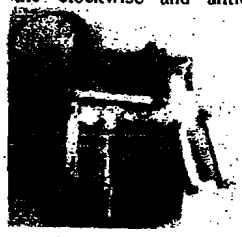


Figure 7. Working diagram of gripper

This type of rotation helps in the movement of the gripper. Here the rotational motion of the servomotor is converted into linear motion of the hands of the gripper.

8. Additional Circuitry works to help in the controlled movement of the gripper

1) Placing a tactile switch

Here on the gripper fingers a switch, called tactile switch is used. This switch is used for detecting to the size of the object, and to give the necessary grip to hold the required object, without creating any damage.

2) Placing a sensor circuit

Here a sensor circuit can be placed either at the front of the gripper fingers or near the linkages. By using sensor circuit, the robot can detect the object from any distance required, and it can send the microcontroller a signal to open the gripper fingers [7]. Special sensor circuits can be end send such that the color of the objects can be detected and the necessary colored object can be lifted.

9. Conclusion

The robotic grippers are designed having a pivoting and linear movement via microcontroller controlled operations is very different, the guidelines applied to both equally well. The assembled gripper along with the microcontroller and sensor network could be made as an Intelligent Mobile Gripper in future.

10. Reference

[1] S.Darooghehe, Design and development of a miniature roboticgripper, Master's diss., Villanova University, Villanova, PA,2002.

[2] Duc Truong Pham, S. S. Dimov, V. O'Hagan , *Advances in Manufacturing Technology XV* (John Wiley and Sons,2001).

[3] W. Hessler. "How to build simple, effective pick-andplace devices," *Robot Today*, vol. 9, no. 4, pp. 1-5, 1996.

[4] G. Causey and R. Quinn. "Gripper design guidelines for modular manufacturing," in IEEE Int Con. Robot.

[5] Robotic Gripper Sizing: The Science, Technology and Lore By: Ted Zajac, Jr. President of ZAYTRAN, Inc.

[6] Brain Carisle, et. al. A Pivoting Gripper for Feeding Industrial Parts. IEEE International Conference on Robotics and Automation Proceedings, 1650-1655, 1994.

[7] Frank L. Merat, et. al.. Advances in Agile Manufacturing IEEE Incarnation Conference on Robotics and Automation Proceedings, 1216-1222, 1997.

[8] Steve Walsh. Gripper design: guidelines for effective results. Manufacturing Engineering v. 93, 53-55, November 1984.