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Pick and Place Robot: a smart Tool for Irregular Objects using Mechanical Gripper

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Abstract

The existing pick and place robots are used toper form pick and place the components on the assembly line. These components are similar in their shape and size. In this project we designed pick and place robot to handle a different shape and size and also irregular objects. The existing design had more numbers of actuators and mechanisms are used to perform the pick and place operation. Hence it's become so expensive. In our design consist of four pneumatic actuators and single rack and pinion mechanism, within this we can able to achieve the existing results. While comparing to the existing robot cost, it is very less. Finally our pick and place robot can able to perform the pick and place the irregular components on 260o within the workspace.

Keywords: *Rack & pinion mechanism; Pneumatic arm; Pick and place robot*

INTRODUCTION

Robotics is related to electronics, mechanics, and software. Robotics research today is focused on developing systems that exhibit modularity, flexibility, redundancy, fault tolerance, a general and extensible software environment and seamless connectivity to other machines, some researchers focus on completely automating a manufacturing process or a task, by providing sensor based intelligence to the mechanical arm, while others try to solidify the analytical foundations on which many of the basic concepts in robotics are built. In this

highly developing society time and man power are critical constrains for completion of task in large scales. The automation is playing important role to save human efforts in most of the regular and frequently carried works. One of the major and most commonly performed works is picking and placing of jobs from source to destination. Present day industry is increasingly turning towards computer-based automation mainly due to the need for increased productivity and delivery of end products with uniform quality.

COMPONENTS OF MECHANICAL ARM

Pneumatic actuators

Pneumatic actuators, of which cylinders are the most common, are the devices providing power and movement to automated systems, machines and processes. A pneumatic cylinder is a simple, low cost, easy to install device that is ideal for producing powerful linear movement over a wide range of velocities, and can be stalled without causing internal damage.

Figure1: Pneumatic actuators

The basic construction of a typical single cylinder isshown in the Fig. 1. The diameter or bore of a cylinder determines the maximum force that it can exert and the stroke determines the maximum linear movement that it can produce. Cylinders are designed to work at different maximum pressures up to 16 bar. The pressure actually supplied to a cylinder will normally be reduced through a pressure regulator to control the thrust to a suitable level. As an example of cylinder power, a 40 mm bore cylinder working at 6 bar could easily lift an 80 kg man.

There are two types of Pneumatic actuators:

- Single Acting Cylinder.
- Double Acting Cylinder

Flow Regulator

The most versatile type of adjustable flow regulator is the unidirectional, line mounted model. The Fig. 2 Represent Conventional Flow Regulators. The Conventional flow regulators the line mounted flow regulator can be fitted at any position in the line between the valve and cylinder ports determined by the application. It can be fitted either way

round to suit conventional exhaust or special inlet regulation requirements. It consists of a screw with a tapered needle end. As the taper is screwed further into the orifice, so flow is increasingly restricted. When flow is reversed, the orifice disc which also forms a non return valve, lifts to allow unrestricted flow.

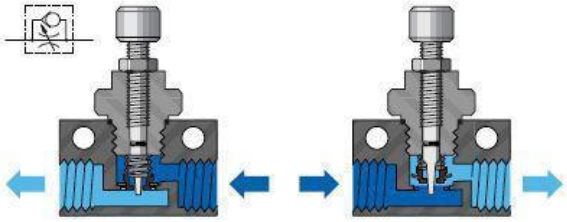

Figure 2: Conventional Flow Regulators

Flow Control Value

This valve is used to control the speed of the piston movement and also it acts as an one way restriction valve which means that the air can pass through only one way and it can't return back. By using this valve the time consumption is reduced because of the faster movement of the piston.

Figure 3: Flow control valve

Directional Control Values

Directional control valves control the way the air passes and use for controlling the commencement, termination and direction of air flow. Depending on the number of paths the air is allowed to take, directional valves are termed as two way, three way, and four way or multi way valves. The different number of ways by means the number of controlled connections of the valve, inlet connections to the compressed air supply. The Outlet connection is given to the air consumer and exhaust connection is given to the atmosphere.

Figure 4: Directional control valves

Types of Directional Control Value

- 3/2 Directional control valve
- 4/2 Directional control valve
- 4/3 Directional control valve

- 5/2 Directional control valve
- 5/3 Directional control valve

Grippers

End effectors used to grasp and manipulate objects. It isjust like a hand, an end-effector enables holding, tightening, handling and releasing of an object. An end-effector can be attached to a robot or it can be part of a fixed automation system. The end-effector is also called as gripper. It is mounted to a wrist of the robot. It is the standard gripper that uses fingers to physically grasp and manipulate objects.

A mechanical gripper is used as an end-effector in a robot for grasping the objects with its mechanically operated fingers. In industries, two fingers are enough for holding purposes. More than three fingers can also be used based on the application.

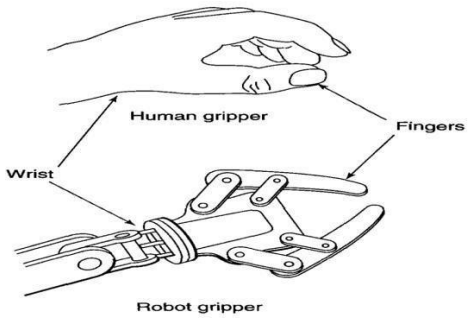

Figure 5: Mechanical Gripper

LITERATURE REVIEW

M.Thangavel and V.Sathishkumar [1] tell about mechanical gripper design. There are designed to performing more than one operation in single end effector. An end effector can be changed as per the application. The robot has more than one arm.the objectives of this project are to designing are configurable end-effector that can perform more than one operation and also reduce the cost of end effector.

Santosh and co [2] tell about The designed pneumatic arm consists of two cylinders, a shaft works with lead screw mechanism capable of converting motion of piston to rotational motion of arm with help of using compressed air. The designed processes are carried out based on integrated information of kinematics dynamics and structural analysis of the desired robot configuration as whole. It can be used in loading and unloading of goods in a shipping harbour as the movement of goods is done from lower plane to higher plane. Atul yadav and co [3] tell about The key role of the project is to design and manufacture The pick and place system which will perform on the assembly line of Thermostat valve. It can

also save the cost in long term and help to solve problems and task that cannot be done such as on time temperature area narrow area and very heavy load things. mr. deepak l rajnor a.s Bhide [4] tell about This paper presents a mechatronics color sorting system solution with the application of image processing. Image processing procedure senses the objects in an image captured in realtimeby a webcam and then identifies color and information out of it.

This information is processed by image processing for pick-and-place mechanism. The Project deals with an automated material handling system. It aims in classifying the colored objects by colour, size, which are coming on the conveyor by picking and placing the objects in its respective pre-programmed place1Yea-Dat Chuah and co [5] tell about This paper presents the design and development of a pickand- place machine for integrated circuit (IC) packages.

The performance of the machine has been tested in terms of pickand- place speed and placement repeatability. The outcome was a pick-and-place machine that is capable to achieve speeds of up to 1500UPH using a simple design and readily available industrial components. S. Premkumar and co [6] tell about Robot manipulator is an essential motion subsystem component of robotic system for positioning, orientating object so that robot can perform useful task The main aim of our work is to collaborate the gripper mechanism and vacuum sucker mechanism working in a single pick and place robotic arm.

This robot can be self operational in controlling, stating with simple tasks such as gripping, sucking, lifting, placing and releasing in a single robotic arm. By using this collaborated mechanism the success rate of pick and place robots are increased.

Chavan d k and co [7] tell about Robotic pick andplace a system consists of a loading station, testing station, processing station, and sorting station. The process involves the pick and place operation for the friction welding machine, for loading and unloading operation of raw material. An optimum assembly design is then achieved with workable sub designs of the manipulator components. Further with best machining process and cheapest material, catering the strength and

machining requirements suitable materials areselected to fulfil the objective.

B.O.Omijeh and co [8] tell about The design analysis of a Remote Controlled "Pick and Place" Robotic vehicle has been presented in this paper. This work unravels the fact that man would always want to adhered to safety precautions at workplace and even in its environment, to be able to handle some specific tasks, like sending the robotic vehicle to hazardous environment to obtain samples for chemical analysis. A prototype of the Remote Controlled "Pick and Place" Robotic vehicle was built to validate design specifications. Giorgio Figliolini and Pierluigi Rea [9] tell about the design and test of a vacuum gripper and an automatic packaging machine, are proposed as examples of components and systems operating in on/off environment. Pneumatic and electro-pneumatic components find several applications in the industrial environment, mainly to solve problems of product automation.

Shweta Bisht and co [10] tell about The systemincorporates pneumatics components to drive an arm, pneumatic pressure cylinders in the form of clinical syringes, supply lines. The arm consists of a pneumatic hand and pneumatic wrist which can grasp various. Small, light-weight objects without force sensors or feedback control. These features make the wrist motions difficult to control as the wrist is used in material handling systems, its motions need to be freely controlled. To that end, in this research, experimental model of the drive system of the pneumatic robot wrist has been constructed. Ravikumar Mourya and co [11] tell about There are numerous dimensions over which robotic arms can be evaluated, such as torque, payload, speed, range, repeatability and cost, to name a few. Robot manipulators are designed to execute required movements.

WORKING PRINCIPLE

The experimental setup consist of four cylinders, allare of double acting type. The cylinder1 is used to actuate rack and pinion assembly, piston rod of cylinder 1is connected to rack, which is meshed with the pinion. By operating the cylinder1, rack and pinion turns the whole mechanical arm assembly for 260□. By varying the length of the rack the turning angle can be altered. Vertical cylinder or cylinder2 is used to increase the height of

the setup. The height is limited to piston rod length. Horizontal cylinder or cylinder3 is used to increase the arm length, the working area of the arm is limited to length of the piston rod length. Gripper cylinder or cylinder4 is used to actuate the gripper.

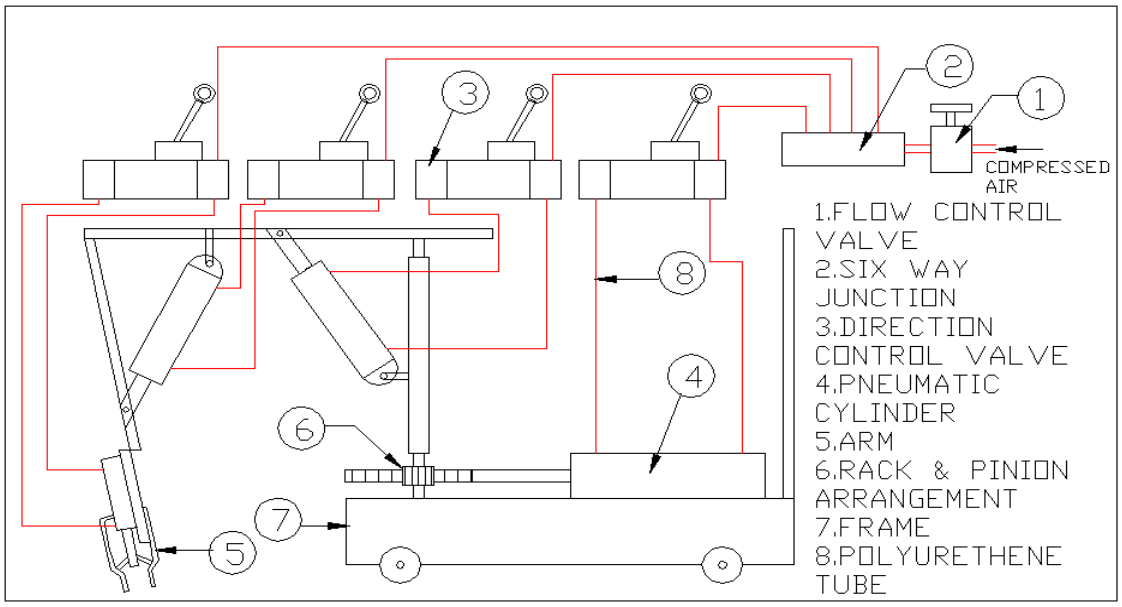

Figure 6: Layout of 4 axis pick & place robot

Figure 7: 4 Axis pick & place robot

Advantages

- The pneumatic arm is more efficient in the technical field
- Quick response is achieved
- Simple in construction
- Easy to maintain and repair
- Cost of the unit is less when compared to other robotics
- No fire hazard problem due to over loading
- Comparatively the operation cost is less
- The operation of arm is faster because the medium used to operate is air
- Continuous operation is possible without stopping.

Limitations

- While working, the compressed air produces noisetherefore a silencer may be used.
- High torque cannot be obtained

CONCLUSION

Thus the existing design and mechanism of the pick and place robots are revived and different types are pick and place robot was studied. By using these We designed a New "Four-Axis Material Handling Robot UsingMechanical Gripper".Finally our pick and place robot can able to perform the pick and place the irregular components on 260o within the workspace.

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