Design, Modelling and Fabrication of Advanced Robots

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Design And Development of Pneumatic Actuated Robotic Arm with Multipurpose Gripper

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Abstract: *Grippers are attached at the end of an industrial arm robot for material handling purpose. Grippers plays a major role in all pick and place application industries. Those are connected as end effectors to realize and develop a task in an industrial work floor. Pneumatic gripper works with the principle of compressed air. The gripper is connected to a compressed air supply. When air pressure is applied on the piston, the gripper gets opened while the air gets exist from the piston it gets closed. It is possible to control the force acting on the gripper by controlling the air pressure with the help of the valve. The results from these experiments demonstrate that the master-slave attitude control can be realized by using an accelerometer and a simple analytical model of the robot arm. The trajectory control also was realized for a square trajectory by using an analytical model and a compact control system. C measured one is relatively large compared with typical robot arm. This is because by a friction that is existing in a rod-less type flexible pneumatic cylinder. The control performance can be improved by reducing the friction or by improving the control scheme. Pneumatic actuators have a number of advantages over electric motors, including strength-to-weight ratio, tunable compliance at the mechanism level, robustness, as well as price. The handling of materials and mechanisms to place of objects from lower plane to higher plane and are widely found in factories and industrial manufacturing. Pneumatic actuators have a number of advantages over electric motors, including strength-to-weight ratio, tunable compliance at the mechanism level, robustness, as well as price. The handling of materials and mechanisms to place of objects from lower plane to higher plane and are widely found in factories and industrial manufacturing.*

1. INTRODUCTION

In an aging society with fewer children, it is strongly desired to develop a system to aid in nursing care and to support the activities of daily life for the elderly and the disabled. The actuators need to be flexible so as not to injure the human body. We have been aiming at developing a flexible and lightweight actuator and applying it into the flexible robot arm, the rehabilitation device and so on. So far, we have proposed and tested the new types of flexible pneumatic actuator that can be used even if the actuator is deformed by external forces such as flexible pneumatic rotary actuator. We have also proposed and tested a flexible robot arm with simple structure by using of the rod-less type flexible pneumatic cylinders. This arm has a potential to be used as a rehabilitation device for human wrist.

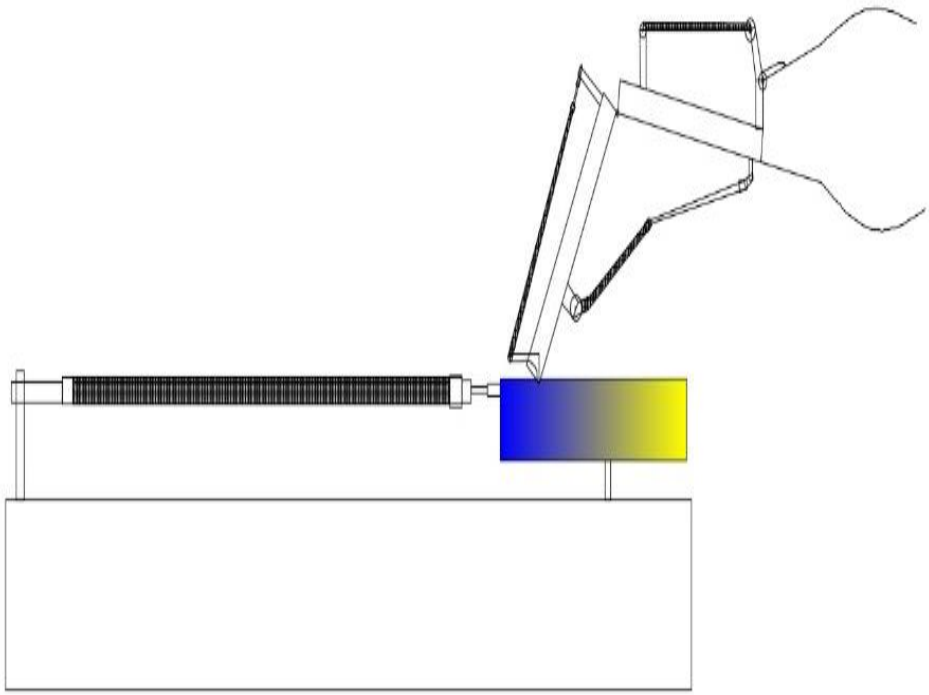
2. METHODOLOGY

The mechanical structure of the Robotic Arm is made of easily accessible low-cost plastic sheet. It designs in such a way as to accommodate the actuators and the control circuit. The fingers consist of three linkages so that its movement look like that of the human finger. The opposing thumb design in such a way that it was connected to the palm using a pivot joint. Then it moves like a human thumb. The whole part then attached to a plastic sheet and base is attached ply wood to keep it in position. The human hand glove consists of a triple axis accelerometer and five flex sensors attached to it to control the hand movement. The whole part then made wireless to enable it to be operate from a far-off place by using a ZigBee transmitter- receiver module. This analog voltage is given to the inbuilt ADC of the microcontroller. The processed digital signal is sent to the control circuitry of the robotic arm using the ZigBee transmitter module. The ZigBee receiver module then receives the digital values and they are use as the control signal to the servo motor.

3. PNEUMATIC ARM

A Robotic Arm can be compared to a human hand. It has a free rotating joint (rotation) and a translational joint (displacement) for the movement of the arm. This arm movement is usually driven by an electric driver (motor) or a pneumatic and a hydraulic system (pistons). These actuators are controlled by a microcontroller (CPU), usually programmable and made to perform a set of sequential tasks. Most of these robotic arms are designed to be used for industrial purposes for fast and reliable performance, helping for mass productions. This robot has five axes which are driven by DC motors (24Vdc) and it is made to be controlled manually by using sets of two potentiometers for each joint.

4. CAD DIAGRAM



5. MATERIALS USED

FIGURE 5. Pneumatic Cylinders

The pneumatic cylinder converts the pressure energy of a compressed air medium into mechanical energy in the form of linear or rotary motion. Pneumatic cylinders are Mechanical Device which use the power of compressed gas to produce a force in a reciprocating linear motion. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. We prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage. They have two ports to allow air in, one for outstroke and one for instroke. Stroke length for this design is not limited, however, the piston rod is more vulnerable to buckling and bending. Additional calculations should be performed as well. It is Calculated By,

$$F = A\sigma$$

FIGURE 6. Gripper Claw

Grippers are devices that enable robots to pick up and hold objects. When combined with a collaborative robot arm, grippers enable manufacturers to automate key processes, such as inspection, assembly, pick & place, and machine tending. We are using 2 finger grippers to pick and place the rectangular and square shaped objects. In This one end is fixed and another end is moved by the pneumatic cylinders.

FIGURE 7. Pneumatic Valves

A pneumatic valve, also known as a directional control valve, controls the flow of compressed air or other gasses inside a system by blocking or diverting it. These valves are used to pilot other valves and to drive other components such as an actuator, gripper, hand tool, or other devices. We used 4 pneumatic valves for 4 Pneumatic Cylinders. Each Pneumatic Cylinder Posses each different motions for pick and place an Object.

FIGURE 8. Solenoid Valves

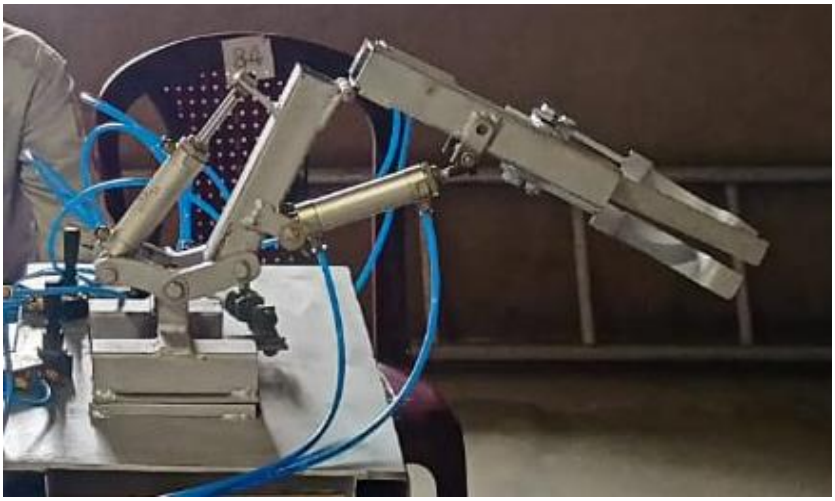
A solenoid valve is an electrically controlled valve. The valve features a solenoid, which is an electric coil with a movable ferromagnetic core. It works by producing an electromagnetic field around a movable core, called an armature. When compelled to move by the electromagnetic field, the motion of that armature opens and closes valves or switches and turns electrical energy into mechanical motion and force. While solenoid valves are powered by DC, that current passing through the coil creates an electromagnet which produces an attractive force on the armature. When current is applied through the coil, the armature will always be pulled towards the coil, regardless of the contact and current polarity.

Push-in Fittings Barbed Fittings Threaded Fittings Click Fittings

FIGURE 8. Pneumatic fittings

Push-in Fittings: Straight to the Right Fittings- a Reliable Solution for every solution.
Barbed Fittings: Push-in Connection with additional Mechanical Locking.
Threaded Fittings: Line connection components with additional functions, such as Rotational, Self-Sealing etc,
Click Fittings: Quick and Simple tube installation using one hand is taken.

6. PROJECT MODEL



7. WORKING PRINCIPLE

It starts Working when the compressor generates the compressed air and then moves to a reservoir, which stores the air. Valves then control the air flow, and circuits control the valves moving the air between the pneumatic cylinders which makes forward and backward motion. By this way when all the 4 Pneumatic Cylinders moves, the structure makes pick and Place operation.

8. CONCLUSION

The design and fabrication of pneumatic arm for pick and place is completed with economic and effective considerations. It is controlled by manually flow control and direction control valves. Pneumatic arm movement and rotation is done by pneumatic cylinder using a helical slot mechanism. The gripper is also a pneumatic actuator which holds objects which are rectangular in shape. The maximum pay load is yet to be calculated and total weight of arm is 25kgs. The model is expected to lift objects of at least 10 kgs weights. The controlling of pneumatic arm for automation is studied with economic and effective considerations. It is controlled by manually flow control and direction control valves. Robotic arm can reduce the human efforts by automatic handing of material, an automatic, servo controlled, freely programmable, multipurpose manipulator, with several areas for the handling of work pieces, tools, or special devices. The gripper is also a pneumatic actuator which holds objects which are rectangular in shape. The controlling of pneumatic arm for automation is studied with economic and effective considerations. It is controlled by manually flow control and direction control valves. Robotic arm can reduce the human efforts by automatic handing of material, an automatic, servo controlled, freely programmable, multipurpose manipulator, with several areas for the handling of work pieces, tools, or special devices. The gripper is also a pneumatic actuator which holds objects which are rectangular in shape. The compact and inexpensive control system of the flexible robot arm for both master-slave control and trajectory control was proposed and tested. The system consists of the microcomputer, compact and inexpensive quasi-servo valves, accelerometers, and the tested robot arm. For the master-slave control system, a simple analytical model that can calculate the displacement of the flexible cylinder using the output voltage from the accelerometer was proposed. We also had proposed the analytical model and control procedure for the trajectory control system

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