# ELECTRO PNEUM ATIC 6 DOF ROBOTIC ARM

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***Abstract***— *Human needs are rapidly increasing today, and technology is moving in the same direction. The work done to meet these needs makes daily life easier, and these studies are centered on robotics. In fact, in recent years, scientists have been using the term "Robot" to refer to any man-made machine that can perform work or other action normally performed by humans, either automatically or by remote control because of this ubiquitous robotic machine due to precision work and action which people can't do, besides robot can work in dangerous regions where human can't work. A pneumatic robotic arm system that can transport objects from one location to another and uses air as its primary power source. An electro or electronic operation is one that involves circuits, electronic devices, and systems. The robotic arm is controlled by four pneumatic valves. The valves regulate the air supply to the pneumatic actuators in order to control the movement of the cylinder stroke. The valves provide manual control over the entire arm's movement. A tiny cylinder drives a gripper arm, which operates the grip, in this method. The fourth pneumatic valve controls the air flow to the gripper actuator and, as a result, the grip. The other valves work together to complete the arm movement, which is held together by a network of linkages and connection rods.*

## I. INTRODUCTION

Aluminum steel is utilized because it is solid, non-magnetic, non-lustrous, and corrosion resistant due to a self-protecting oxide coating. It is also an excellent electrical and thermal conductor. Aluminum can also be used for industrial and construction machinery.

The pneumatic robotic arm will showcase a variety of movements, from grabbing, lifting, an object and placing it in a desired location. Pneumatics is a type of engineering that uses gas or pressured air as a main source of power. A robotic arm is a sort of mechanical arm that is generally programmable and performs duties comparable to a human arm; the arm may be the sum of the mechanism, or it may be part of a larger robot. The links of such a manipulator are joined by joints that allow for either rotational or translational movement.

Grippers are basic devices that allow robots to take up and hold items. Grippers, when linked with a collaborative robot arm, allow manufacturers to automate important tasks including inspection, assembly, pick and place, and machine tending.

Learn more about pneumatics and make the necessary calculations. Inspired by a variety of online products as material, it is cheaper, and anyone can learn and understand more about pneumatics. Actual images and demonstrations will help you understand the purpose of the machine.

## II. WORKING PRINCIPLE

A pneumatic robotic arm system that can transport objects from one location to another and uses air as its primary power source. An electro or electronic operation is one that involves circuits, electronic devices, and systems. A pneumatic system is one that uses gas or pressurized air. The robotic arm is controlled by four pneumatic valves. The valves regulate the air supply to the pneumatic actuators in order to control the movement of the cylinder stroke. The valves provide manual control over the entire arm movement. A tiny cylinder drives a gripper arm, which operates the grip, in this method. The fourth pneumatic valve controls the air flow to the gripper actuator and, as a result, the gripping. The other valves work together to complete the arm movement, which is held together by a network of linkages and connection rods

When gas or pressurized air starts to circulate inside the cylinders it can now perform a desired movement and can be controlled by actuators. Actuators are linked to the rein a push button type controller that allows you to manipulate the machine in a certain way possible. The arm can grab, lift, and position any object within its mass range.

To carry it out, we made a table that has a caster attached at the bottom as a base for our robot. Using the cylinders, we connect it as a joint for the movement. A rotary actuator is used for the rotation, and it can rotate up to 180 degrees. With the help of the gripper arm the robot can grab and lift an object and place it in a desired location.

The robotic arm has a total length of 80 cm or 0.8 m and that can lift a 3 kg. An air compressor is used to increase the pressure and decrease the volume of a gas, such as air as its fundamental function. Using a pressure filter regulator that converts a supply pressure to a lower outlet pressure and attempt to maintain this outlet pressure despite intake pressure changes.

## III. MATERIALS USED

The purpose of this machine is to make industrial machinery easier to run and to save costs because it employs air as a power source. Engineering students can profit from this as well since it will help them learn more about pneumatics.

The materials used in this experiment are readily available in pneumatic stores. It is simple to locate and would not be expensive to purchase.

- Air Compressor, a pneumatic device that turns power into potential energy stored in pressured air is known as an air compressor.


- Pneumatic solenoid valves are used to guide the flow of compressed air. A movable element within the valve blocks or opens the valve's ports. The moving component is known as a spool or piston. The movement of the spool can be controlled in two ways: directly or indirectly.


- Filter regulator lubricator is used to make a gas or liquid reach a specific pressure; pressure regulators automatically cut off the flow. Are also used to regulate the pressure in high-pressure fluid supply tanks or lines to a useful and safe level for various purposes.


- Rotary actuator is a type of actuator that generates rotating motion or torque. A butterfly valve is controlled by an electric rotary valve actuator.

- Gripper arm is a mechanical or electrical End of Arm Tooling (EOAT) device that allows an item to be manipulated. In other words, it is the controlled "hand" of a machine that grasps and releases pieces that are being moved by automation.


- Pneumatic cylinders are mechanical devices that produce force using the energy of pressurized air. These devices consist of a piston, a piston rod and a cylinder. The pressure inside the cylinder increases when air enters from one side of the cylinder. The increase in internal pressure causes the piston to move in a specific direction. The piston rod transmits the developed force to the object to be moved.

- Flow control valve adjusts and controls the volume flow of air in a pneumatic system. They can often be used to adjust the operating speed of an actuator. They should not be confused with pressure monitors or regulators. Although there is a relationship between pressure and flow, it is not necessarily linear and using a pressure regulator to control flow can result in wasted energy and potential damage components.

- Pneumatic silencer is used to exhaust pressurized air to atmosphere. Depending on the flow rate and pressure of the air exiting the exhaust port, pneumatic air exiting the unit may produce noise potentially harmful. In addition to noise, exhaust air can emit contaminants during operation. Using an exhaust muffler cleaner can prevent harmful contaminants from entering the environment.

- Pneumatic T fitting is used to connect compressed air tools to a compressed air line. A pneumatic joint connector allows a tool to be easily connected or disconnected from a hose or pipe when under pressure. The fitting automatically closes the line as soon as it is disconnected from a component, ensuring the system remains pressurized.

- Pneumatic L fittings are characterized by an angled joint, commonly 90 degrees (right-angle). Pneumatic elbow fittings are used to connect either single or multiple hoses and can allow the user to easily change the connections in a system for an assortment of tubes or pipes.

- Caster wheel is an undriven wheel that is connected to the bottom of a bigger item to allow it to be moved. Shopping carts, office chairs, toy wagons, medical beds, and material handling equipment all make use of casters.

- push-button switch is a mechanical device used to control an electrical circuit in which the operator manually presses a button to actuate an internal switching mechanism. Pushbutton switches rely on a simple in-out actuation mechanism. They can be used to interrupt (off) or initiate (on) a circuit. Alternatively, they can provide input for a device's user interface or start/stop a particular function

- Rolling element bearings contain rolling elements in the form of balls or cylinders. We know that rolling a wheel is easier than sliding it on the ground because the magnitude of rolling friction is less than that of sliding friction. The same principle is at work here. Rolling element bearings are used to facilitate the free movement of rotating moving parts. Rolling elements carry the load without much friction as the sliding friction is replaced with rolling friction.

- Pneumatic tubing and hoses are used to transmit pressured air to actuators, valves, tools, and other equipment. There are several choices for connecting air preparation systems, valves, and cylinders in the business. Pneumatic tube and hose are more commonly used than rigid tubing.

- Aluminized steel is carbon steel that has been hot-dipped and coated with an aluminum-silicon alloy. The process forms a strong metallurgical link between the base metal (carbon steel) and its alloy covering, resulting in a new material that combines the best properties of steel and aluminum.

- A switched-mode power supply is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source to DC loads, such as a personal computer, while converting voltage and current characteristics.

## IV. PROCEDURES

Some of you might want to reproduce this apparatus for class or personal use and study. So here are the procedures for creating a pneumatic robotic arm.

A. First, gather all the materials and tools needed to complete this project. Pneumatic cylinder, solenoid valve, filter regulator lubricator, pneumatic hand grip, air compressor, rotary actuator, flow control valve, push button, smps, bearing, pneumatic silencer, pneumatic tube, pneumatic fittings all are included**.**

B. Prepare the base for the robotic arm. Choose a table and fix the caster wheel by welding.

C. Cut required length of Aluminized steel for robotic arm and forearm.

D. Fix another pneumatic cylinder on the basement with linear moving part of the robotic arm.

E. Fix the rotary actuator over the moving part of the robotic arm.

F. Make a platform over the rotary actuator and place a hole on the platform for fix the actuator. After that fix the bearing over the rotary actuator and do welding for make it strong.

G. Fix the hand gripper with robotic forearm and make flexible joint between forearm and arm.

H. Joint the pneumatic cylinder between forearm and arm. After that joint another cylinder between robotic arm and platform which is over the bearing.

I. Connect the pneumatic tube and wire connections between switches, solenoid valve and smps.

## V. MACHINE ANALYSIS

This robotic arm based on the pneumatic system. We used switched mode power supply for the operation and power supply for the solenoid valves. We control the movements of the robotic arm by push button switches.

Pneumatic solenoid valves are control air supply by allowing flow or restricting it using a plunger located in the solenoid core. And it is controlling pneumatic cylinders and hand gripper through push button switches.

The length of the robotic arm and forearm are 40cm respectively. We used two different stroke sizes of pneumatic cylinders. Two cylinders were connected to robotic arm and it is move the hand for pick and place. These two cylinders stroke sizes are 12cm respectively.

We can find the flow capacity (CV) of the piston from this formulas;

$$Cv = \frac{\text{Area (in}^2\text{) x Length (ins) x Compression Factor}}{\text{Pressure Drop Factor x Time (secs) x 29}}$$

Area = Effective cylinder piston area in square inches
(A = 3.1416 x radius².....or.....A = diameter² x .7854)

- 6 inch bore cylinder / 2 inch rod thickness / 15 inch total stroke
- 2 second total travel time / 100 psi supply pressure
- We will use a 15 psi pressure drop factor

- 6" diameter piston bore area in square inches for extend calculations
  A = d² x .7854
  = 6² x .7854
  = 36 x .7854
  = 28.27 (in²) piston area
- 2" diameter rod end area in square inches
  A = d² x .7854
  = 2² x .7854
  = 4 x .7854
  = 3.1416 (in²)
- Cylinder return area=28.27 - 3.1416
  = 25.12 (in²)

$$\text{Extend} \geq \frac{28.27\ (\text{in}^2) \times 15" \times 7.8}{37.4 \times 2\ \text{secs} \times 29}$$

$$= \frac{3307}{2169}$$

= 1.52 Cv to extend

So, here used pistons are 1.52 flow capacity rating.

## VI. CONCLUTION

Six degrees of freedom (6DOF) refers to the six mechanical degrees of freedom of movement of a rigid body in three-dimensional space. Specifically, the body is free to change position as forward/backward (surge), up/down (heave), left/right (sway) translation in three perpendicular axes, combined with changes in orientation through rotation about three perpendicular axes, often termed yaw (normal axis), pitch (transverse axis), and roll (longitudinal axis).


Pic : ELECTRO PNEUMATIC 6 DOF ROBOTIC ARM

## VII. REFERENCES

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