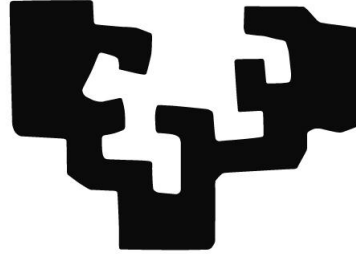


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Universidad
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Pneumatic and Hydraulic Systems

Pneumatically Operated Robotic Arm

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Introduction:

Robotic arms are used in different fields to serve different purposes. Robotic arms are used in many areas such as Industrial Automation, Medical Applications, space research, submarine research, Military and Defense, Service Sector, Agriculture and laboratory studies. Pneumatic systems can be used in the design of a robotic arm due to their low cost, simple design and fast response time. Robotic arms working with pneumatic systems are generally used in Industrial Automation, Food Industry and Packaging Industry.

Advantages of designing a robotic arm with pneumatic system:

- Pneumatic arms provide fast and accurate movement, making the movement fast. It is also possible to adjust how fast a pneumatic system can and cannot move.
- Pneumatic systems are simpler to design. This makes pneumatic systems easier to design, manufacture and maintain.
- Pneumatic systems are safe. Pneumatic system components are long-lasting and robust. This increases the reliability of pneumatic systems.
- Pneumatic systems are powerful. Pneumatic systems can provide a significant amount of power even in small sizes. This makes it possible to produce lightweight but very robust arms.

Disadvantages of robotic arms powered by pneumatic systems:

- Pneumatic systems offer less precise movement capability. This makes it impossible to design a robotic arm with a pneumatic system in some specialized areas.
- A pneumatic system cannot work without an air supply. This limits the use of pneumatic systems in some areas.

Components that make up a robotic arm working with pneumatic systems.

- Pneumatic cylinders are the parts that perform the movement. When air is applied, the piston inside the cylinder moves back and forth, controlling the robotic arm's movements back and forth, left and right, up and down, and pick and drop.
- Air pressure is applied to make pneumatic cylinders work. The air pressure is provided with the help of a compressor.
- We provide the movements of the robotic arm with control valves. The valves control the supply of air pressure to the cylinders. These valves facilitate the forward or backward movement of a particular cylinder, thus realizing the desired movement of the arm.
- Mechanical parts: Mechanical parts are all the mechanical components that make up the robotic arm. They are specifically designed to perform some function or can be used to hold the system together.

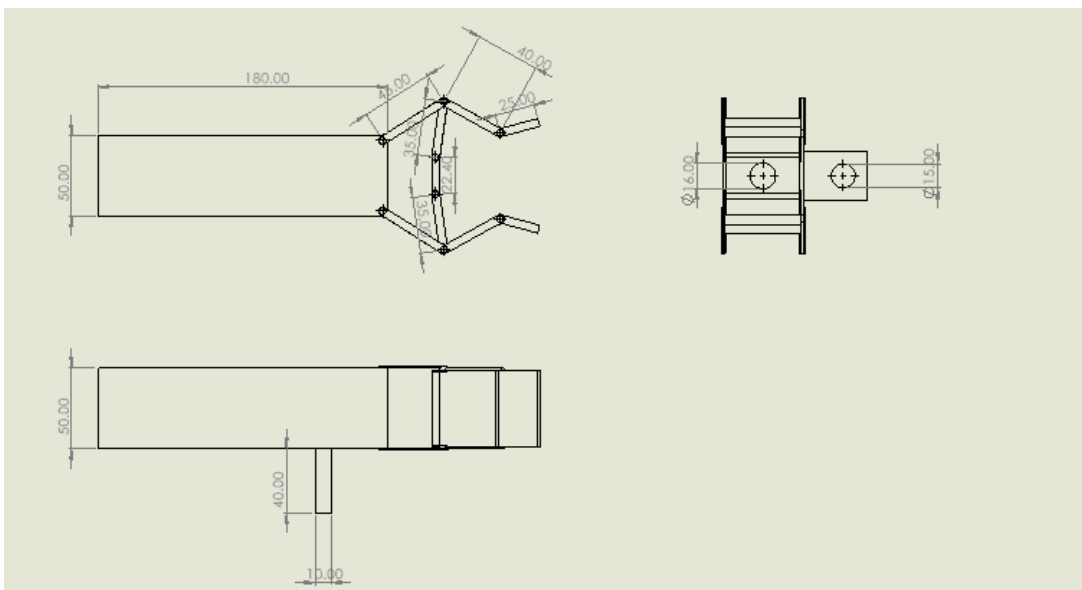
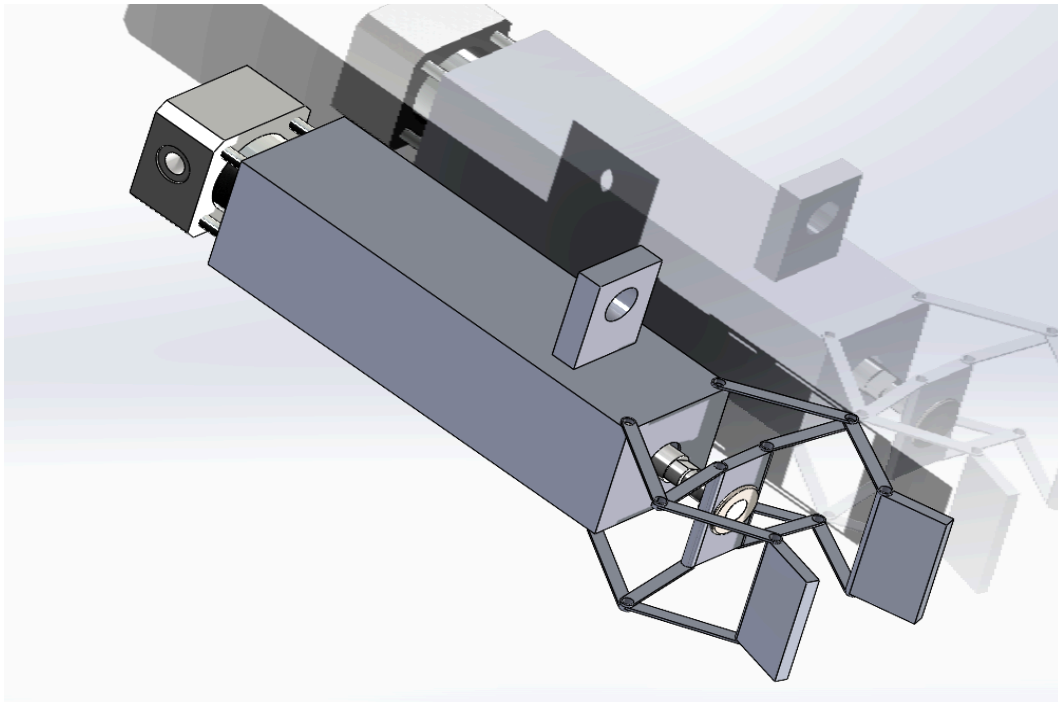
I designed a robotic arm with a pneumatic system to transfer a product or item from one point to a different point. The robotic arm with the pneumatic system I designed can perform functions such as right and left rotation, elongation and shortening, up and down movement and holding and releasing. The robotic arm I designed can be used in factories to transfer a product from one belt to another. As the design develops, it is possible to develop a robotic arm capable of serving different purposes.

The robotic arm is a combination of mechanical parts and pneumatic systems.

Mechanical parts

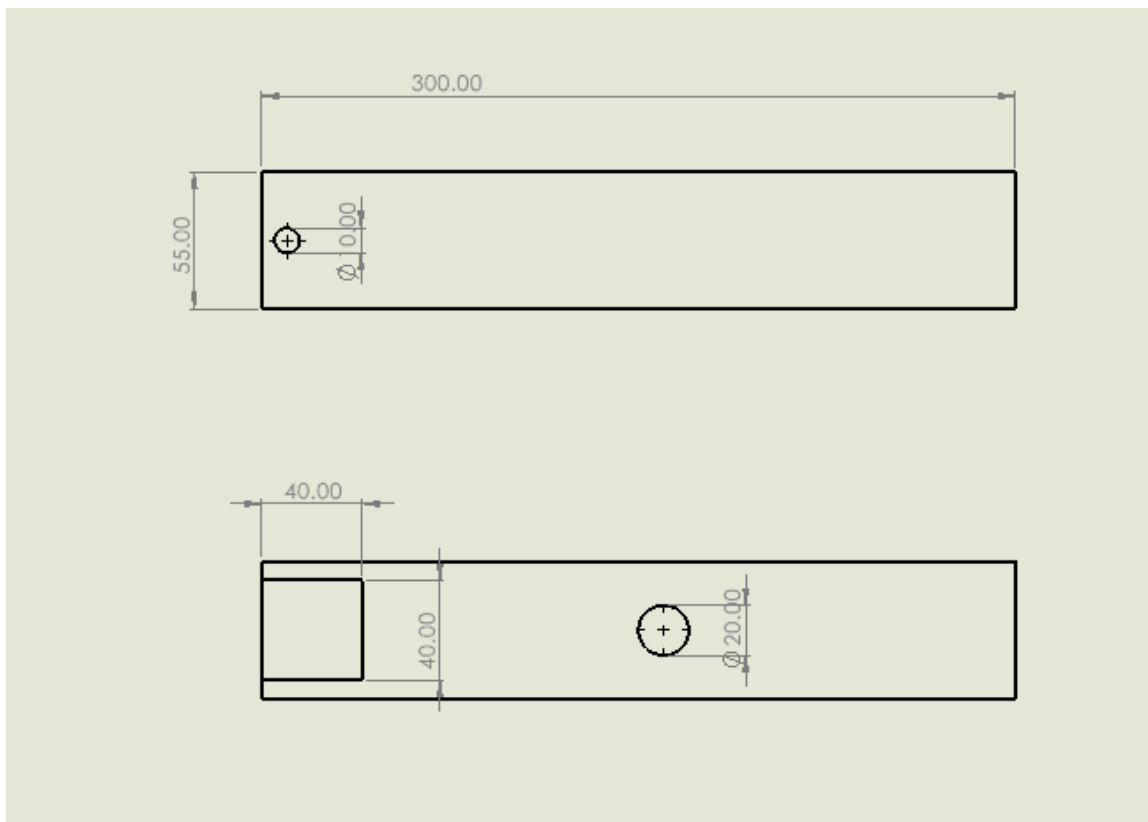
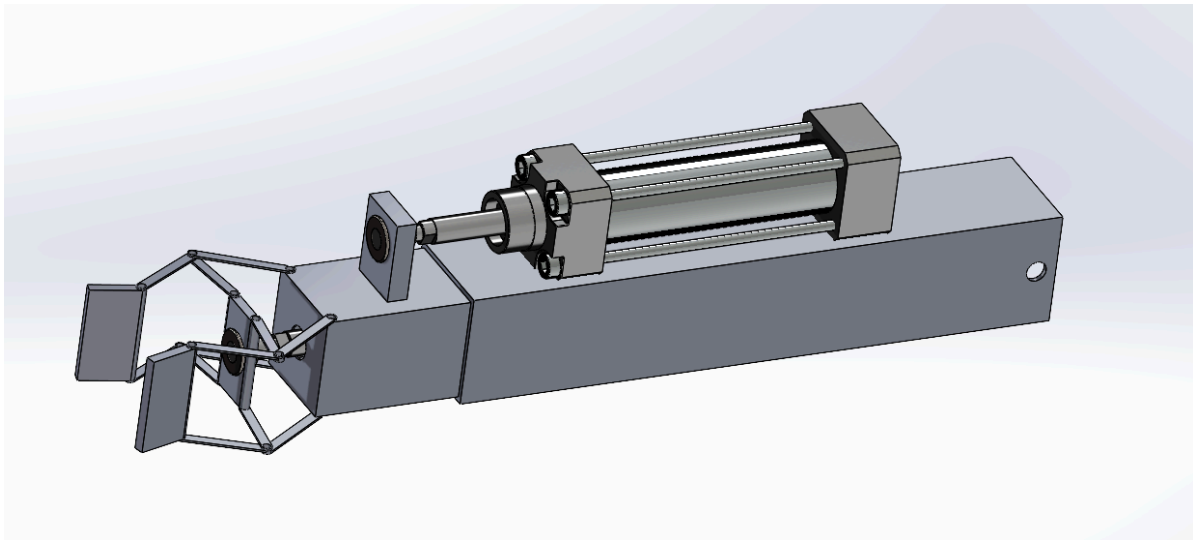
1-) Grippers and Tools

The gripper is the part that allows the robot arm to pick up and release a product. This part is connected to a pneumatic cylinder. When the piston in the cylinder moves backwards, the arm can grasp the target product. When the piston moves forward, the arm releases the product.



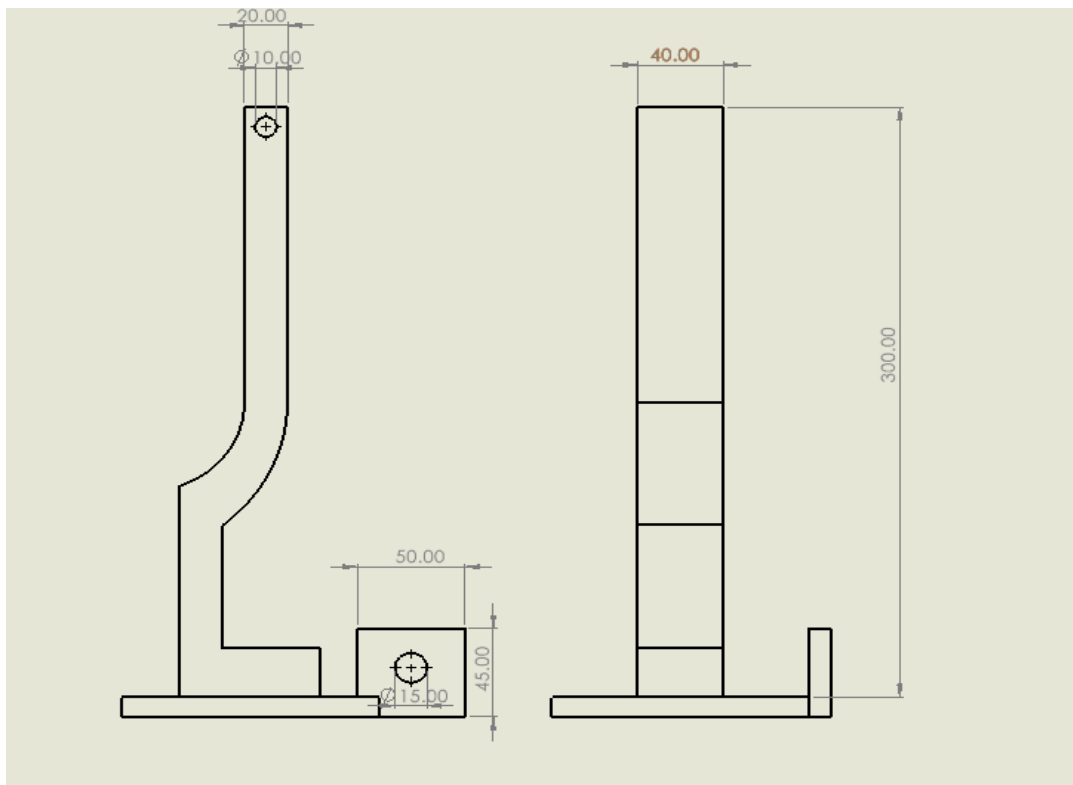
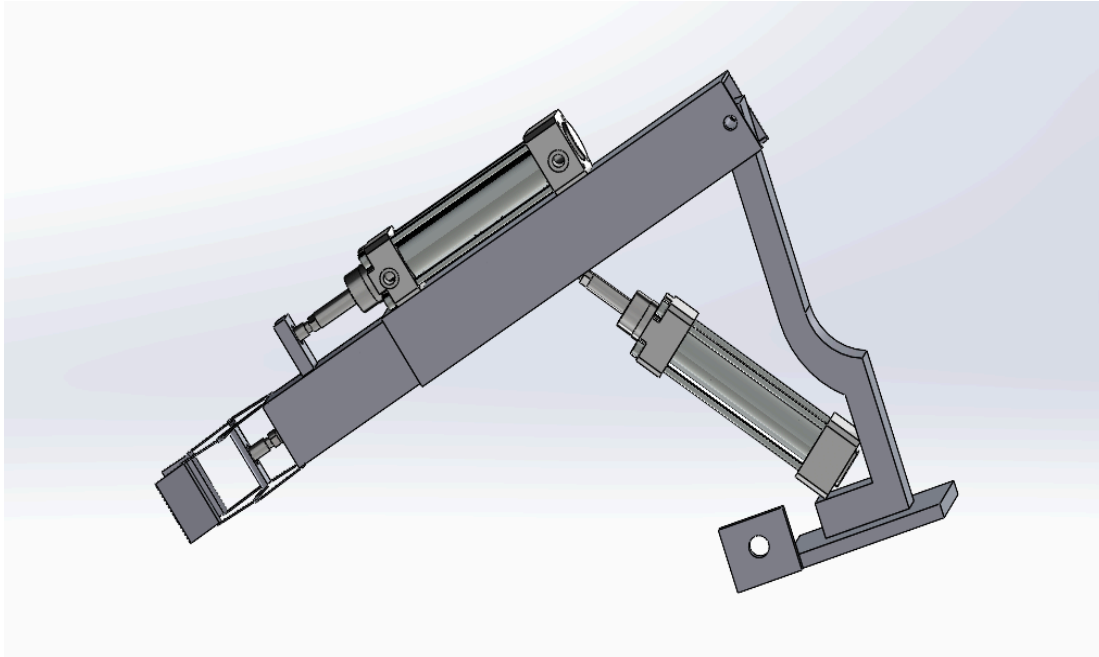
2-) Middle body

The center body part is connected with the cylinder with gripper. The gripper is designed to fit inside the center body. When the piston of the cylinder on the center body moves forward, the gripper extends forward, when the piston moves backward, the gripper moves backward and shortens.

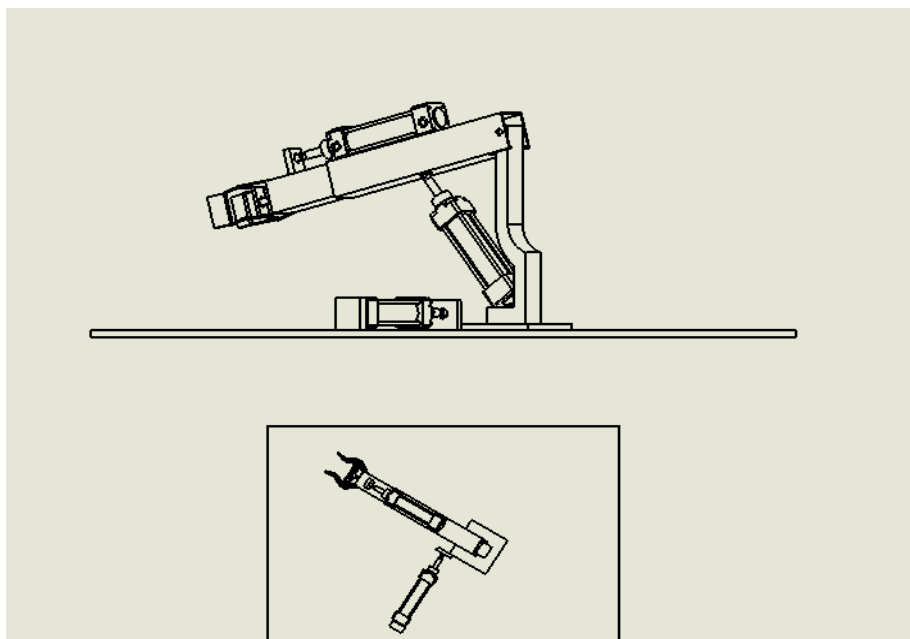
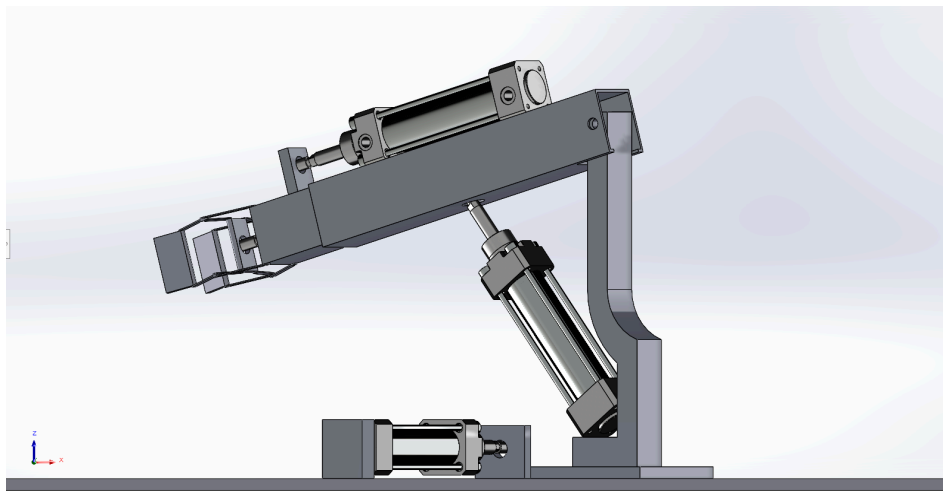
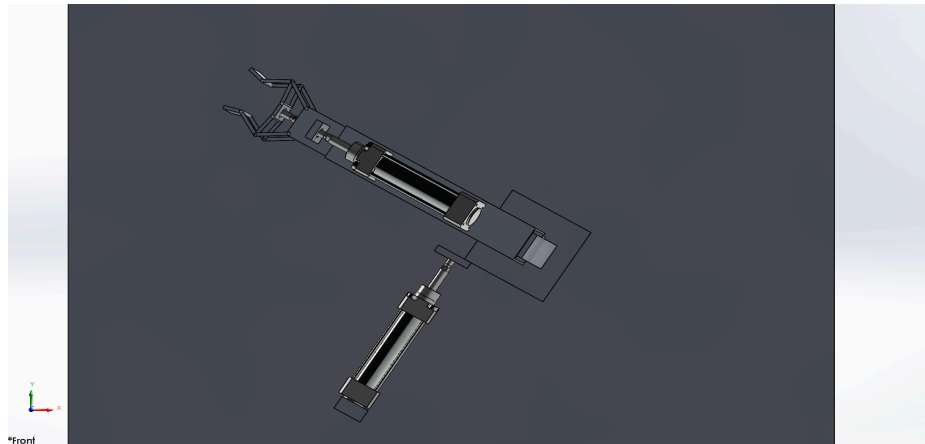


3-) Robotic arm stand

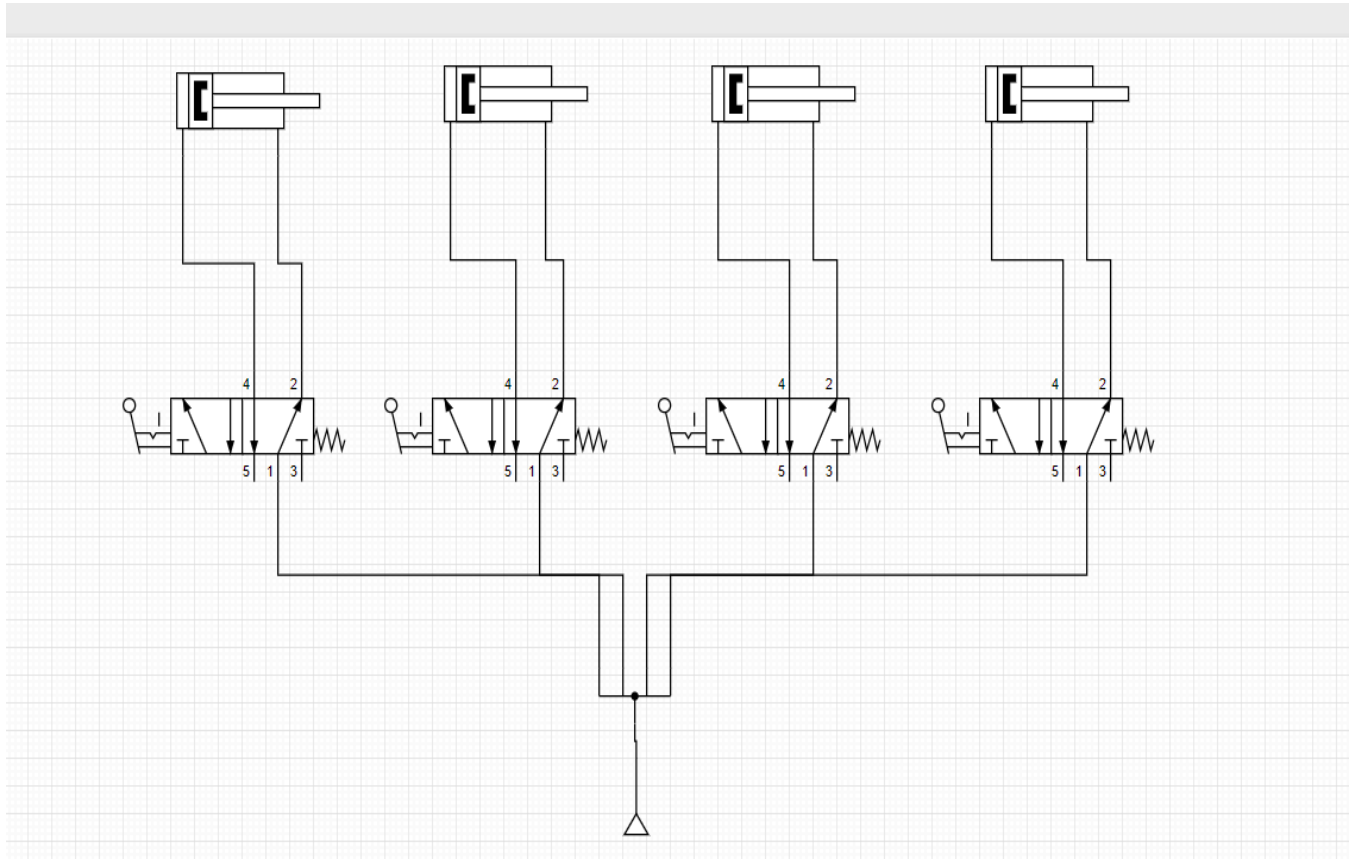
The robotic arm stand is the stand where the robotic arm will be fixed or placed on the floor. Thanks to the cylinder between the robotic arm stand and the extension body, the robotic arm moves up and down.



Final design



Pneumatic circuit elements and drawing



Pneumatic Elements

- 4 Double acting cylinders

Mechanical movement of the Robot Arm with pneumatic system is provided by cylinders. Double acting cylinders are used in the system. Double-acting cylinders allow us to control the movement of the robotic arm bidirectionally through valves.

Each of the 4 cylinders performs the mechanical movement of the robotic arm. They enable the robotic arm to perform all its movements for its purpose. For example, let the robotic arm be a machine that transfers a product from one belt to another in a factory. The robotic arm is manually controlled to reach the position of the target product by rotating, reaching or moving up and down. The robotic arm holds the target product. The robotic arm picks up the product as intended and places it on another belt.

- 4 5/2 Mechanical valves

In pneumatic systems, valves are mechanical components used to control the flow of compressed air or gas. A valve allows or prevents air or gas to flow in a certain direction in a pipeline. In short, valves can be thought of as gates that regulate flow in pneumatic systems. These valves are used to allow or stop the flow of compressed air or gas in the desired direction and there are various types, such as one-way valves, control valves, pressure regulators, etc.

I used a 5/2 mechanical valve in the robotic arm design because the term "5/2" indicates that the valve has five ports and operates in two positions. These valves are often used in simple pneumatic systems such as robotic arms or industrial automation applications. The 5/2 mechanical valve is controlled by a lever. The air pressure coming into the valve through the lever is used to control the movement of the cylinder. The lever is the means by which the person using the robotic arm will control the movements of the robotic arm.

- Pressure source

Air pressure is usually supplied using compressors and pneumatic systems create mechanical movement using the power of compressed air.

Flowchart

As we learned in pneumatics lessons, I drew a flow chart for the piston to make A+ and A- movements. While drawing the pneumatic circuit, I chose a valve that can provide A+ and A- movements of the piston with the help of a lever. In this way, the cylinder will perform A+ and A- movements by manually controlling the lever with a single valve control.

