



# **SNS COLLEGE OF TECHNOLOGY**

## **(AN AUTONOMOUS INSTITUTION)**

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## **Department of Biomedical Engineering**

### **ROBOTICS AND AUTOMATION IN MEDICINE**

**III Year : VI Semester**

**TITLE:END EFFECTOR**



# END EFFECTOR

- An end effector is the device at the end of a robotic arm, designed to interact with the environment.
- The exact nature of this device depends on the application of the robot.
- The end effector means the last link (or end) of the robot.
- In a wider sense, an end effector can be seen as the part of a robot that interacts with the work environment.
- They may consist of a gripper or a tool.





# GRIPPERS



- A gripper is the end of arm tooling (EOAT) device that allows your robot to manipulate an object.
- A gripper is your robot's mechanical “hand” that grasps and releases parts that are being moved as a result of your automation directions.
- Robotic grippers are used in a wide range of industries, including automotive, aerospace, medical, and food and beverage.

V2





# CATEGORIES OF ROBOTIC GRIPPERS

1. **Impactive:** jaws or claws which physically grasp by direct impact upon the object.
2. **Ingressive:** pins, needles or hackles which physically penetrate the surface of the object (used in textile, carbon, and glass fiber handling).
3. **Astrictive:** attractive forces applied to the object's surface (whether by vacuum, magneto-, or electroadhesion).
4. **Contigutive:** requiring direct contact for adhesion to take place (such as glue, surface tension, or freezing).



Vacuum Gripper



Pneumatic Gripper





# MECHANISM

- Generally, the gripping mechanism is done by the grippers or mechanical fingers. Two-finger grippers tend to be used for industrial robots performing specific tasks in less-complex applications. The fingers are replaceable.
- The shape of the fingers' gripping surface can be chosen according to the shape of the objects to be manipulated.

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# LEVELS OF FORCE



- Though there are numerous forces acting over the body that has been lifted by a robotic arm, the main force is the frictional force.
- The gripping surface can be made of a soft material with high coefficient of friction so that the surface of the object is not damaged.
- The robotic gripper must withstand not only the weight of the object but also acceleration and the motion that is caused by frequent movement of the object.



# LEVELS OF FORCE



To find out the force required to grip the object, the following formula is used

$$F = \frac{ma}{\mu n}$$

$F$  is the force required to grip the object,  
 $m$  is the mass of the object,  
 $a$  is the acceleration of the object,  
 $\mu$  is the coefficient of friction and  
 $n$  is the number of fingers in the gripper.

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A more complete equation would account for the direction of movement. For example, when the body is moved upwards, against gravitational force, the force required will be more than that towards the gravitational force. Hence, another term is introduced and the formula becomes:

$$F = \frac{m(a + g)}{\mu n}$$



# TOOLS



- The end effectors that can be used as tools serve various purposes, including spot-welding in an assembly, spray-painting where uniformity of painting is necessary, and other purposes where the working conditions are dangerous for human beings. Surgical robots have end effectors that are specifically manufactured for the purpose.



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