NIELIT, Gorakhpur

Course Name: A-level (1st Sem.) **Subject: IoT**

Topic: Introduction to Actuators **Date: 04.05.2020**

An actuator is a device that actuates or moves something. An actuator uses some type of energy to provide motion or to apply a force. An actuator requires a control signal and a source of energy. The control signal is relatively low energy and may be electric voltage or current, pneumatic or hydraulic pressure, or even human power. Its main energy source may be an electric current, hydraulic fluid pressure, or pneumatic pressure. When it receives a control signal, an actuator responds by converting the source's energy into mechanical motion. For example, an electric motor uses electrical energy to create a rotational movement or to turn on object, or to move an object. A tire jack or screw jack uses mechanical energy to provide enough force lift a car. In short, an actuator converts some type of energy into motion. Actuators include motors, gears, pumps, pistons, valves, and switches.

Types of Actuators

Hydraulic

A hydraulic actuator consists of cylinder or fluid motor that uses hydraulic power to facilitate mechanical operation. The mechanical motion gives an output in terms of linear, rotatory or oscillatory motion. As liquids are nearly impossible to compress, a hydraulic actuator can exert a large force. The drawback of this approach is its limited acceleration.

The hydraulic cylinder consists of a hollow cylindrical tube along which a piston can slide. The term *single acting* is used when the fluid pressure is applied to just one side of the piston. The piston can move in only one direction, a spring being frequently used to give the piston a return stroke. The term *double acting* is used when pressure is applied on each side of the piston; any difference in pressure between the two sides of the piston moves the piston to one side or the other.

Pneumatic

Pneumatic actuators enable considerable forces to be produced from relatively small pressure changes. A pneumatic actuator converts energy formed by vacuum or compressed air at high pressure into either linear or rotary motion. Pneumatic energy is desirable for main engine controls because it can quickly respond in starting and stopping as the power source does not need to be stored in reserve for operation. Moreover, pneumatic actuators are safer, cheaper, and often more reliable and powerful than other actuators. These forces are often used with valves to move diaphragms to affect the flow of air through the valve.

Electric

An electric actuator may provide the actuation force/torque in one of several ways. Electromechanical actuators may be used to power a motor that converts electrical energy into mechanical torque. Another approach is an electrohydraulic actuator, where the electric motor remains the prime mover, but provides torque to operate a hydraulic accumulator that is then used to transmit actuation force in much the same way that diesel engine/hydraulics are typically used in heavy equipment.

Electrical energy is used to actuate equipment such as multi-turn valves, or electric-powered construction and excavation equipment.

When used to control the flow of fluid through a valve, a brake is typically installed above the motor to prevent the fluid pressure forcing open the valve. If no brake is installed, the actuator gets activated to reclose the valve, which is slowly forced open again. This sets up an oscillation (open, close, open ...) and the motor and actuator will eventually become damaged.

Thermal or magnetic

Actuators which can be actuated by applying thermal or magnetic energy to a solid-state material have been used in commercial applications. Thermal actuators can be triggered by temperature or heating through the Joule effect and tend to be compact, lightweight, economical and with high power density. These actuators use shape memory materials such as shape-memory alloys (SMAs) or magnetic shape-memory alloys (MSMAs).

Mechanical

A mechanical actuator functions to execute movement by converting one kind of motion, such as rotary motion, into another kind, such as linear motion. An example is a rack and pinion. The operation of mechanical actuators is based on combinations of structural components, such as gears and rails, or pulleys and chains.