1. Role of Sensors and Actuators in Healthcare

Sensors in Healthcare

Sensors are devices that detect and measure physical parameters (like temperature, pressure, heart rate, etc.) and convert them into signals that can be read and processed.

Common Types & Roles:

Sensor Type	Parameter Measured	Application / Role
Temperature Sensor	Body temperature	Used in digital thermometers, patient monitoring systems
Heart Rate Sensor (ECG Sensor)	Heartbeat and ECG signals	Used in heart rate monitors, pacemakers
Blood Pressure Sensor	Blood pressure level	Used in automatic BP monitors
Oxygen Sensor (SpO_2 Sensor)	Oxygen saturation in blood	Used in pulse oximeters
Glucose Sensor	Blood sugar level	Used in glucose monitoring devices for diabetics
Motion/Accelerometer Sensor	Movement and posture	Used in fall detection for elderly patients
EEG Sensor	Brain electrical activity	Used in brain monitoring systems
Respiration Sensor	Breathing rate	Used in ventilators and respiratory monitoring systems

Actuators in Healthcare

Actuators are devices that convert electrical signals into physical action (motion, pressure, etc.) — often used to respond or assist based on sensor data.

Actuator Type	Role in Healthcare

Motor Actuators	Operate robotic arms in surgeries and rehabilitation
Pump Actuators	Deliver precise doses of medicine or fluids (e.g., insulin pumps)
Valve Actuators	Control flow in medical devices like ventilators
Heating/Cooling Actuators	Regulate temperature in incubators or therapy devices
Piezoelectric Actuators	Used in ultrasound imaging devices
Microfluidic Actuators	Used in lab-on-chip diagnostic systems

Example: Smart Hospital Bed

Sensors: Detect patient's heart rate, temperature, and movement.

Actuators: Automatically adjust bed height or angle for comfort and safety.

2.Role of Automobile in Case Study (Automation / Sensors & Actuators in Automobiles)

Automobiles today use sensors and actuators to improve safety, comfort, and efficiency — often studied as case studies in automation or IoT.

Sensors in Automobiles

Sensor Type	Role / Function
Oxygen Sensor	Monitors exhaust gases to control engine fuel mixture
Speed Sensor	Measures wheel or vehicle speed for ABS and traction control
Temperature Sensor	Monitors engine and cabin temperature
Proximity/Ultrasonic Sensor	Detects obstacles for parking assist
Pressure Sensor	Measures tire pressure or brake pressure
Camera/LiDAR Sensor	Used in autonomous vehicles for object detection
Rain Sensor	Automatically activates wipers
Airbag Sensor (Impact Sensor)	Detects sudden deceleration to deploy airbags

Actuators in Automobiles

Actuator Type	Role / Function
Throttle Actuator	Controls air intake to engine electronically
Brake Actuator	Applies brakes in ABS or automatic braking systems
Fuel Injector Actuator	Controls fuel flow to engine cylinders
Wiper Motor Actuator	Operates windshield wipers
Door Lock Actuator	Automatically locks/unlocks doors
Steering Actuator	Used in power steering and autonomous driving

Example Case Study: Automatic Emergency Braking (AEB) System

Sensors Used: Radar + Camera detect obstacles in front.

Controller: Processes data and decides if collision risk is high.

Actuator: Activates braking system automatically to prevent collision.

Summary Comparison

Field	Sensors	Actuators	Purpose
Healthcare	Monitor human biological parameters	Provide physical action (like pumping, moving, or controlling)	Patient monitoring, diagnosis, and treatment
Automobile	Monitor vehicle and environment conditions	Control mechanical systems	Safety, efficiency, comfort, and automation