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Internet of Things

Assignment 1

Q.1. Differentiate between sensors, actuators and transducers?

Sensors are devices that can measure or quantify, or respond to the ambient changes in their environment (within an intended zone of their deployment. They generate responses to external stimuli through characterization of the input functions. The responses are generally electrical signals. For ex., a barometer, a temperature sensor etc.

An actuator is a machine by which a control system acts upon an environment upon recieving a control signal. It responds by converting the energy into mechanical motion. For ex. a generator or a dc motor. etc.

Transducer converts one form of energy to another. It can act as a sensor or an actuator but not simultaneously. For ex. a microphone, speaker etc.

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Q.2 How is sensor resolution different from its accuracy?

Resolution of a sensor is defined as the smallest change that can be measured in the physical quantity by a sensor. For Ex. A sensor with 0.1°C resolution can measure a temperature of 37.6°C but not 37.65°C.

Accuracy of a sensor is defined as the closeness between the sensor output and the actual value of the physical quantity. For Ex. A sensor measuring 99°F temperature, when it is 100°F, is 99% accurate.

Increasing resolution doesn't necessarily mean increasing accuracy.

Q.3 Differentiate between Scalar and Vector sensor?

The sensor which produces an output proportional to the magnitude of quantity being measured is known as scalar sensor. It measures scalar data. For ex. temperature sensor, barometer etc.

The sensor which produces an output proportional to the magnitude, direction as well as

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orientation of quantity being measured is known as vector sensor. It measures vector data. for ex. Sound sensor, velocity sensor etc.

Q.4 Define offset, hysteresis, quantization, aliasing and sensitive errors with examples.

Sensitive Errors: This deviation or error occurs due to sensor fabrication or calibration. Under real conditions, the sensitivity of a sensor may differ from the value specified for that sensor leading to sensitivity errors. For ex.- the actual quantity goes beyond the sensor's measuring limit.

Offset Error: If the output of a sensor differs from actual measured value by a constant the sensor is said to have an offset error or bias. For ex: A barometer measuring 0.01 atm pressure more than the actual pressure everywhere.

Hysteresis Error: If a sensor's output varies due to the deviations in the sensor's previous input values, it is referred to as hysteresis error. Ex. heating of metal strips has hysteresis error

Quantization Error: If the sensor has a digital

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output, the output will be an approximation of the measured property; this induces quantization error. Ex. A digital speedometer.

Aliasing Error: If the input variable changes periodically or at a frequency proportional to multiple of sampling rate, aliasing error may occur. For ex. a signal component with frequency 12.5 KHz will cause aliasing error while acquiring data from 3 channels having sampling rate 100 KHz.

Q.5 Define hydraulic, pneumatic and soft actuators with examples.

Hydraulic Actuator: It works on the principle of compression and decompression of fluids. These facilitate mechanical tasks of load lifting through use of hydraulic power derived from fluids in cylinders. The mechanical motion applied to hydraulic actuator is converted to either linear, rotary or oscillatory motion. They are considered as stiff systems. For ex. hydraulic car jack etc.

Pneumatic Actuator: It works on the principle of compression and decompression of gases.

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These actuators use vacuum or compressed air at a high pressure and convert it into either linear or rotary motion. These are considered to be compliance system. For ex. pneumatic brakes in vehicles, etc.

→ Resistance of a material against deformation is known as stiffness. Compliance is opposite of stiffness.

Soft Actuators: They consist of elastomeric polymers that are used as embedded fixtures in flexible materials such as clothes, paper, fiber etc. The conversion of molecular level microscopic changes into tangible macroscopic deformations is the primary working principle of these actuators. For ex. dielectric elastomer actuator etc.

Q.6 Define shape memory alloys, shape memory polymers and light activated polymers.

Shape Memory Alloys: It is an alloy (mixture of metals) that can be deformed when cold but returns to its pre-deformed shape when heated. Ex. copper-aluminium-nickel alloy, etc.

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Shape Memory Polymers: Shape Memory Polymers (SMPs) are considered as smart materials that respond to some external stimuli by changing their shape, and then revert to original shape when stimuli is removed. Ex. used in determining pH changes, light intensity etc.

Light Activated Polymer (LAP): LAP are a type of SMPs that require light as an external stimuli. Using only the variation of light frequency or intensity, LAPs can be controlled remotely without any physical contact.
Ex. Some enamels depend upon photo polymer formulation for proper hardening upon exposure to light.