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Assignment - 1

1 Define briefly what is internet of things (IOT)? write the Characteristics of IOT System.

The internet of Things is a network of interconnected physical objects that can communicate, sense, or interact with their internal states or the external environment. These objects include a wide range of devices - such as sensors, actuators and everyday appliances that are embedded with technology enabling them to exchange data over the Internet or other networks.

Characteristics of IOT System :-

1. Interconnectivity :- IoT allows diverse devices to be connect interconnected and share data across various platforms

2. Heterogeneity :- IoT systems are composed of a mix of devices, sensors, and applications with different capabilities and protocols

3. Scalability :- IoT system are designed to scale with the addition of devices, supporting millions of nodes

4. Dynamic and Adaptive nature :- IoT systems are highly adaptive, automatically configuring and managing devices based on contextual data

2. Difference between IoT and M2M?

1. IoT
   - Scope :- IoT encompasses a vast range of interactions such as device to device, device to people communications
   - Internet connectivity :- it is central to IoT, enabling communications over both private and public networks
   - Components :- IoT systems integrate devices, cloud computing, and data processing which complex analysis and control over a network of devices.

2. M2M
   - Scope :- M2M is focused specifically of machine to machine communications, usually within a limited environment
   - Internet connectivity :- M2M interactions often occur via direct communication channels like cellular or satellite networks
   - Components :- M2M systems usually involve hardware based communication modules to transmit data from one device to another without advanced processing.

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[3] Explain the need of IoT Proxy and IoT Gateway with example.

They play important roles in enabling secure and efficient communication between IoT devices and external networks

IoT Gateway :-

- Purpose :- Acts as a bridge between the IoT LAN and WAN or internet. It is primarily responsible for forwarding packets between LAN, WAN
- Example :- In a smart home setup, an IoT gateway connects local devices like thermostats and smart locks to the wider internet enabling remote control and monitoring.

IoT Proxy :-

- Purpose :- Operates at the application layer to provide enhanced security and address management. IoT Proxies extend the network's addressing range and perform functions like packet filtering, firewalls
- Example :- An IoT Proxy can be used in industrial settings to secure communication between factory sensors and external cloud services by filtering data at the application layer before it reaches the wider network.

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(4) Discuss the challenges faced by IoT with proper justifications

1. Scalability:
With a vast number of devices being connected IoT faces scalability issues. This requires efficient management of resources and handling large volumes of data to ensure performance doesn't degrade as more devices join the network.

2. Security and Privacy:
IoT systems often operate with minimal security protections, making them susceptible to attacks. Devices may lack robust authentication and encryption mechanisms, leading to vulnerabilities in data privacy.

3. Network Reliability:
Many IoT devices rely on unstable or intermittent connectivity, especially in remote or mobile environments.

4. Data management:
IoT generates massive amounts of data making data storage, management, and analysis challenging. Effective data handling strategies are necessary to avoid storage overloads

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(5) Discuss about sensors and their characteristics.

Sensors are devices that detect changes into signals, often electrical, that can be interpreted by other systems. They play a crucial role in IoT applications by enabling real time monitoring and control of various physical phenomena.

Characteristics

- Resolution —
  Higher resolution allows for more precise measurements

- Accuracy —
  Refers to how close a sensor's measurements are to the true value.

- Precision —
  Refers Reflects the sensor's repeatability.
  A highly precise sensor produces consistent results under the same conditions, even if those results are not entirely accurate.

- Response Time :-
  The time taken by a sensor to respond to changes in the measured quantity

- Drift :-
  Refers to gradual changes in a sensor's reading over time, which may occur due to environmental conditions or sensor ageing

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6 Compare Transducers, Sensors, and Actuators with example.

1. Transducers :-
   - Definition :- Transducers convert energy one form to another.
   - Function :- They can operate as either sensors or actuators but cannot do both simultaneously.
   - Examples :- microphones from sound to electrical signals

2. Sensors :-
   - Definition :- Sensors are input transducers that detect and convert various forms of energy (like temperature or pressure) into electrical signals
   - Function :- Sensors quantify environmental changes and transmit these a signals for further processing.

3. Actuators :-
   - Definition :- Actuators are output transducers that ~~do~~ convert electrical signals into other forms of energy, usually mechanical motion
   - Function :- They respond to control signals to create movement or change in a system

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[7] Discuss briefly about Sensor deviations.

Sensor deviation refers to variations in a sensor's output from its expected or accurate readings, resulting in measurement errors.

1. Sensitivity error :- A discrepancy between a sensor's sensitivity in actual conditions and the specified sensitivity value

2. Offset Error - A constant difference between the actual measured value and the sensor's output

3. Non-Linearity :- Some sensors do not have linear transfer function (TF), causing deviation from a straight-line response.

4 Drift : Over time sensors may show progressive changes in output unrelated to the measured quantity.

5. Hysteresis Error :- Some sensors retain a "memory" of past inputs, leadings to differing outputs when the input returns to a previous value

6. Quantization Error :- In digital sensors, quantization error arises from approximating continuous analog signals to discrete digital values

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(5) Illustrate the type of actuators.

1- Hydraulic Actuators
- Operate on the principle of fluid compression and decompression.
- Used Convert mechanical input to linear, rotatory, oscillary motion

2 Pneumatic Actuators
- use Compressed air to generate linear to rotary motion
- known for fast response times and are commonly used in value Controls.

3. Electric Actuators :-
- Powered by electric motors, converting electric energy into torque or rotational motion.
- widely used in applications needing high speed actuation such as solenoid values

4. Thermal Actuators :-
- Utilize thermal or magnetic energy for actuation
- Compact and high power density, ideal for light weight applications

5. Mechanical Actuator :-
- Depend on mechanical Components like gears to Convert motion.
- Used for tasks requiring precise linear movement