Unit-3: Smart Sensors



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Unit-III (CO-III):

Smart Sensors:

Digital transducers, Smart sensors, Fiber optic transducer, Image sensors, IC sensor, MEMS sensor, Advance Sensors.

SMART SENSOR

What is a smart sensor?

A smart sensor is a device that takes input from the physical environment and uses built-in compute resources to perform predefined functions upon detection of specific input and then process data before passing it on.

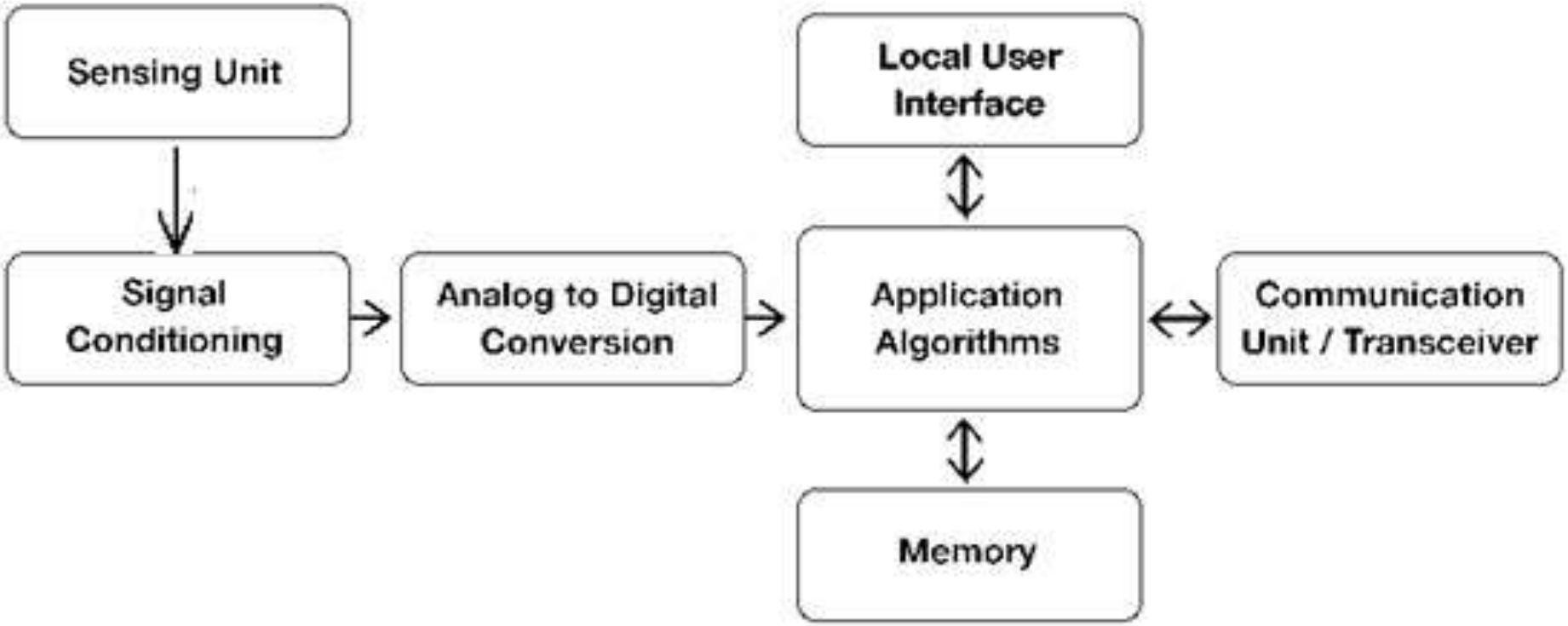
Smart sensors enable more accurate and automated collection of environmental data with less erroneous noise amongst the accurately recorded information. These devices are used for monitoring and control mechanisms in a wide variety of environments including smart grids, battlefield reconnaissance, exploration and many science applications.

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The smart sensor is also a crucial and integral element in the internet of things (IoT), the increasingly prevalent environment in which almost anything imaginable can be outfitted with a unique identifier and the ability to transmit data over the internet or a similar network. One implementation of smart sensors is as components of a wireless sensor and actuator network (WSAN) whose nodes can number in the thousands, each of which is connected with one or more other sensors and sensor hubs, as well as individual actuators.

Compute resources are typically provided by low-power mobile microprocessors. At a minimum, a smart sensor is made of a sensor, a microprocessor and communication technology of some kind. The compute resources must be an integral part of the physical design - a sensor that just sends its data along for remote processing isn't considered a smart sensor.

Smart Sensor Block Diagram



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How do smart sensors work?

A smart sensor ties a raw base sensor to integrated computing resources that enable the sensor's input to be processed.

The base sensor is the component that provides the sensing capability. It might be designed to sense heat, light or pressure. Often, the base sensor will produce an analog signal that must be processed before it can be used. This is where an intelligent sensor's integrated technology comes into play. The onboard microprocessor filters out signal noise and converts the sensor's signal into a usable, digital format. Smart sensors also contain integrated communications capabilities that enable them to be connected to a private network or to the internet. This enables communication to external devices.

What are smart sensors used for?

They are very commonly used in industrial environments and are the driving force behind Industry 4.0.

Factories often use smart temperature sensors to make sure machines aren't overheating, and vibration sensors to make sure machines aren't at risk of vibrating loose. Smart sensors also enable process control, such as monitoring a process, like manufacturing an item, and making any adjustments that might be required to meet quality or production goals. This was once a manual process, but smart sensors can be used to automate process control.

Smart sensors also play a key role in modern security systems. Thermal imaging sensors can be used to detect an intruder's body heat. Similarly, devices such as smart locks, motion sensors, and window and door sensors are commonly connected to a common network. This enables the security sensors to work together to paint a comprehensive picture of the current security status.

How are smart sensors different from base sensors?

Smart sensors include an embedded Digital Motion Processor (DMP), whereas base sensors don't. A DMP is, essentially, just a microprocessor that is integrated into the sensor. It enables the sensor to perform onboard processing of the sensor data. This might mean normalizing the data, filtering noise or performing other types of signal conditioning. In any case, a smart sensor performs data conversion digital processing prior to any communication to external devices.

A base sensor is simply a sensor that isn't equipped with a DMP or other compute resources that would enable it to process data. Whereas a smart sensor produces output that is ready to use, a base sensor's output is raw and must typically be converted into a usable format.

Smart sensors are generally preferred over base sensors because they include native processing capabilities. Even so, there are situations where it might be more advantageous to use a base sensor. If an engineer is designing a device and needs complete control over sensor input, then it will probably make more sense to use a base sensor than a smart sensor. Base sensors also cost less than smart sensors because they contain fewer components.

Although smart sensors are most often associated with industrial equipment, IoT couldn't exist without smart sensors. Learn more about the use cases and benefits of smart sensors for IoT.

What are different types of smart sensors?

There are five main types of smart sensors used in industrial environments. Although there are many types of special purpose sensors in use today, they are generally based on one of five types of sensors.

1.Level sensors. A level sensor is used to measure the volume of space taken up in a container. A vehicle's fuel gauge might be connected to a level sensor that monitors the level of fuel in the tank.

2.Temperature sensors. A temperature sensor is a sensor that can monitor a component's temperature so a corrective action can be taken if necessary. In an industrial setting for example, a temperature sensor can be used to make sure machinery is not overheating.

3.Pressure sensor. Pressure sensors are often used to monitor the pressure of gasses or fluids in a pipeline. A sudden drop in pressure might indicate a leak or a flow control issue.

4. Infrared sensors. Some infrared sensors, such as those used in thermal imaging cameras or noncontact infrared thermometers are used for temperature monitoring. Other infrared sensors are optical sensors tuned to a frequency that enables them to see light in the infrared spectrum. These types of sensors are used in medical equipment, such as pulse oximetry devices, and in electronic devices designed to be operated by remote control.

5. Proximity sensors. A proximity sensor is used to detect the location of a person or object with relation to the sensor. In retail environments, proximity sensors can track customer movements throughout the store.