

SENSORS: SIMPLE TO SMART TO SYSTEMS

PC-based software plus an intelligent remote controller provide the flexibility to configure sensor system inputs, outputs, and data acquisition to a plant's specific needs. The result is greater visibility of plant operations, allowing better decisions to be made.

Sensors are in our home, transportation, and workplace affect our safety, environment, and productivity. You awoke this morning in a warm room because a sensor monitored the room temperature. The car you drove to work has sensors for temperature, oxygen emissions, and more. Its control panels are covered with lights, gauges, and switches. Yet, conflicting data, possible burned-out lights, and trying to read too many gauges, lights and indicators rapidly can make your job difficult and prone to problems.

Sensors are the primary building blocks that provide the vital function of acquiring data and transmitting it to human operators. Just as sensors have permitted a simplified way of flying commercial airlines, sensors provide the necessary information for efficient and effective operation of every process and facility.

Sensors must operate under diverse conditions, 24 hours a day, 365 days a year. Some sensors are designed to operate in extreme temperatures, pressures, flow, and corrosive or hazardous conditions. Sensors development incorporates specific industry needs, including hardened sensors that are resistant to specific environmental conditions, miniaturized sensors, disposable sensors, and sensor systems. Purchasers of sensors must consider the variables of their specific application. As an example, purchasers of gas detection sensors must consider the following when selecting a sensor for their application: speed of response, measurement range, accuracy, resolution, interfering gases, operating range (temperature, humidity, pressure), temperature and humidity effects, sensor life, ease of calibration, calibration frequency, and replacement cost.

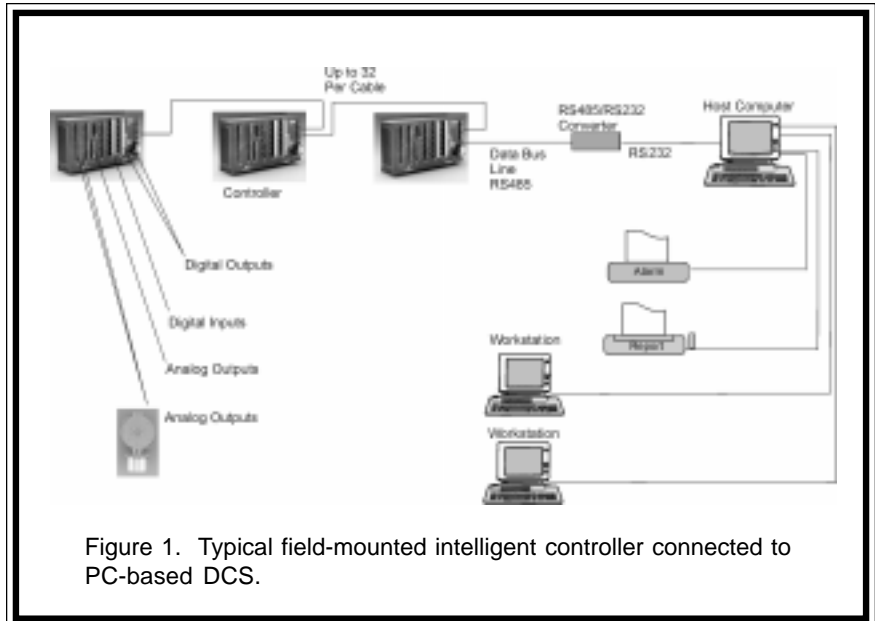


Figure 1. Typical field-mounted intelligent controller connected to PC-based DCS.

Simple Sensors

Historically, sensors have been simple devices capable of monitoring a specific variable. The human operator reviews the data generated by these simple sensors and determines what action needs to be taken. Limitations include:

- All intelligence resides in the sensor controller;
- Communication from sensor to controller is analog;
- Controllers typically are dedicated to specific sensor types;
- Multiple sensors require multiple controllers;
- Calibration requires intrusive manual adjustments of transmitters and a corresponding adjustment of controllers.

Often, because of these limitations, operating decisions are based on the input from only a few devices, concerning a few parameters. Simple sensors generate data but not information. The operator might be concerned about data reliability if the sensor was overdue for calibration, or if the data from a sensor was outside the norm. The process can end in disaster due to inaccurate data because of a burned-out bulb or a stuck needle on a gauge.



Smart Sensors

Smart or intelligent sensors improve the communication from the sensor to controller and improve the reliability of sensor data by better signal processing. Smart sensors use digital signals rather than analog signals to transmit to the controller. Digital signals provide the opportunity for greater diagnostics and data checking.

Smart sensor diagnostics involve continuous checks to identify out-of-bounds system operating criteria. The sensor accesses operating characteristics, checks the operating voltage, and continuously verifies that the dynamic range of the sensor provides adequate resolution. Warning messages from the sensor identify items such as low sensor sensitivity and low battery.

In addition, some smart sensors can deal with detection of intangible properties such as softness, freshness, sweetness, or aroma. New smart sensors in the biological, medical and pharmaceutical world can detect cholesterol and lipids. In the industrial sector, smart sensors have enabled the plant operator to obtain more reliable data.

Sensor Systems

But, more reliable data is still just waiting to be converted into information. Sensor systems have significantly improved operator efficiency by effectively and quickly converting large volumes of data into useful information. The operator needs input from a variety of sensors and locations to make knowledgeable decisions. Today's more powerful sensor systems have the following characteristics:

- Accepts input from various sensors (and various manufactures);
- Provides local display of sensor readings;
- Allows for non-intrusive sensor calibration;
- Provides relays for local alarm action;
- Follows user-defined alarm strategy;
- Accepts feedback signals from final control elements;
- Has independent battery backup;
- Is a low-cost link to the control room;
- Provides centralized monitoring.

Distributed intelligence is central to proper sensor system design philosophy. Since the field controllers are intelligent with the capability to implement alarm logic and operate independently of the host computer,

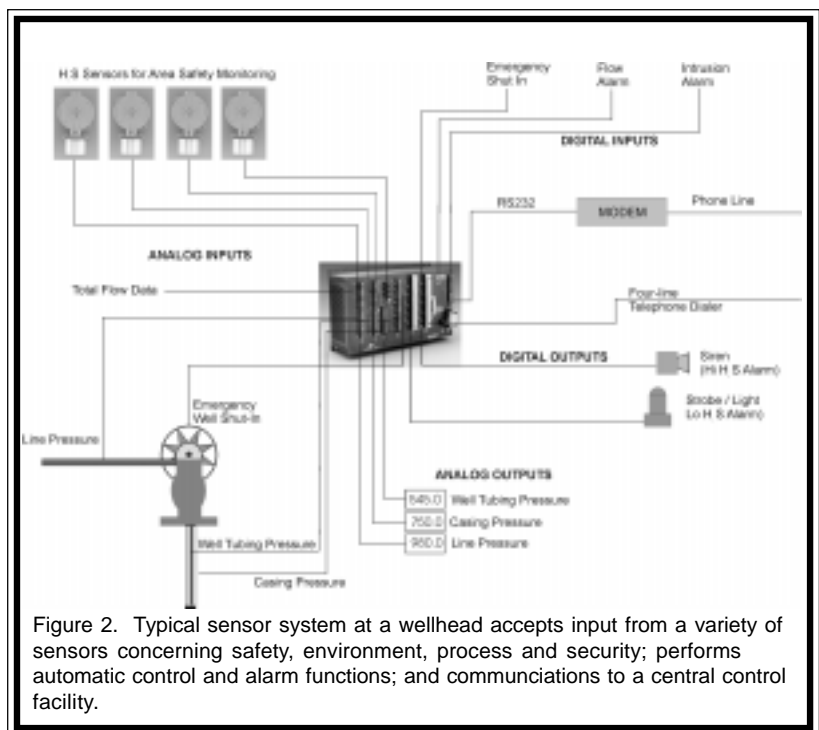


Figure 2. Typical sensor system at a wellhead accepts input from a variety of sensors concerning safety, environment, process and security; performs automatic control and alarm functions; and communications to a central control facility.

interrupted communication with host computer does not hamper field operation. In addition, sensor systems provide the user with clear, understandable data that enables the operator to analyze the situation quickly and take the required action.

A sensor system not only provides the best features of local control and centralized monitoring, but also systemizes the entire monitoring process. The system provides plant personnel with sufficient, reliable information to ensure that decisions are made with maximum knowledge of the current situation. Sensor systems accept a wide range of sensor inputs, including those with non-linear signals. The remote controller conditions to signals, compares with data from various inputs, and transmits the data to the control room. Within the I/O controller, the input values are used for equation processing, alarming, control, event sequencing, and more. Complex control and logic algorithms and parameters for each channel can be constructed and modified by the operator.

Generally, all data from the system is accessible from the control room via simple twisted pair cabling, telephone lines, or radio signals. In the control room, the operator can access data from a variety of sensors. Using PC-based software package combined with an intelligent remote controller provides the user with the flexibility to configure sensor system inputs, outputs, and data acquisition to meet the plant's specific needs. The result is greater visibility of plant operations, allowing better decision to be made.

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