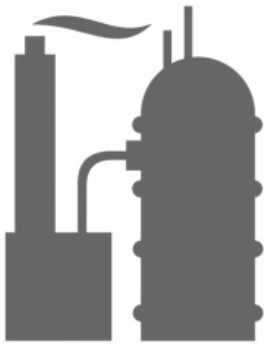

Gas Detection Predictive Maintenance

Overview

Operators use gas detection devices to monitor and prevent gas leaks.

Detection of gas levels and leakages in industrial environments, surroundings of chemical factories and inside mines involves significant costs, and is of crucial importance for operating safety. While preventive maintenance could provide for another IIoT solution, at remote sites it is costly and sometimes ineffective.

Applicable Industries

- Mining
- Oil & Gas

Applicable Functions

- Environmental Health & Safety
- Facility Maintenance

Market Size

Estimate A

The global market for gas analyzers is predicted to be worth USD 3.0 billion in 2020.

Source: Markets and Markets

Estimate B

Another source puts the global gas sensor market at USD 2.5 billion in 2020.

Source: Radiant Insights

Estimate C

The global market for gas detection equipment is predicted to be worth USD 3.4 billion in 2022.

Source: Transparency Market Research

User Viewpoint

Business Value

How does this use case impact an organization's performance?

Gas detection predictive maintenance provides uninterrupted services to the intended users of gas, increasing the quality of service.

Key Performance Indicators

How is the success of the system measured for users and for the business?

Optimized maintenance schedules

Preempted failure alerts

System Capabilities & Requirements

What are the typical capabilities in this use case?

The system provides secure and coordinated machine/device connectivity with enhanced equipment sensing to generate data for predictive maintenance.

Data is distributed to predictive analytics algorithms and monitoring applications (local or cloud).

Stakeholder Viewpoint

Investment Decision Makers & Influencers

Which organizations, departments, or individuals typically makes an investment decision and allocates budget?

Facility management

Administrational office

System Operators

Which organizations, departments, or individuals are responsible for operating and maintaining the system?

Gas pipeline owners and operators

System End Users

Who are the regular users of the system?

Gas pipeline owners and operators

Gas consumers

Technology Viewpoint

Sensors

What sensors are typically used to provide data into the IoT system, and which factors define their deployment?

The electrochemical based gas leak detector is the predominant segment with total share of about 38%, whilst the ultrasonic, semiconductor and infrared based gas leak detector cumulatively accounted for 46.6% % in the global gas leak detector market value in 2014.

Types Gas detectors can be classified according to the operation mechanism (semiconductors, oxidation, catalytic, infrared, etc.). Gas detectors come packaged into two main form factors: portable devices and fixed gas detectors. Portable detectors are used to monitor the atmosphere around personnel and are worn on clothing or on a belt/harness. These gas detectors are usually battery operated. They transmit warnings via audible and visible signals, such as alarms and flashing lights, when dangerous levels of gas vapors are detected. Fixed type gas detectors may be used for detection of one or more gas types. Fixed type detectors are generally mounted near the process area of a plant or control room, or an area to be protected, such as a residential bedroom.

Generally, industrial sensors are installed on fixed type mild steel structures and a cable connects the detectors to a SCADA system for continuous monitoring. A tripping interlock can be activated for an emergency situation.

Electrochemical: Electrochemical gas detectors work by allowing gases to diffuse through a porous membrane to an electrode where it is either chemically oxidized

or reduced. The amount of current produced is determined by how much of the gas is oxidized at the electrode, indicating the concentration of the gas. Manufacturers can customize electrochemical gas detectors by changing the porous barrier to allow for the detection of a certain gas concentration range. Also, since the diffusion barrier is a physical/mechanical barrier, the detector tended to be more stable and reliable over the sensor's duration and thus required less maintenance than other early detector technologies. However, the sensors are subject to corrosive elements or chemical contamination and may last only 1–2 years before a replacement is required. Electrochemical gas detectors are used in a wide variety of environments such as refineries, gas turbines, chemical plants, underground gas storage facilities, and more.

Infrared point: Infrared (IR) point sensors use radiation passing through a known volume of gas; energy from the sensor beam is absorbed at certain wavelengths, depending on the properties of the specific gas. For example, carbon monoxide absorbs wavelengths of about 4.2-4.5 ?m. The energy in this wavelength is compared to a wavelength outside of the absorption range; the difference in energy between these two wavelengths is proportional to the concentration of gas present. This type of sensor is advantageous because it does not have to be placed into the gas to detect it and can be used for remote sensing. Infrared point sensors can be used to detect hydrocarbons and other infrared active gases such as water vapor and carbon dioxide. IR sensors are commonly found in waste water treatment facilities, refineries, gas turbines, chemical plants, and other facilities where flammable gases are present and the possibility of an explosion exists. The remote sensing capability allows large volumes of space to be monitored. Engine emissions are another area where IR sensors are being researched. The sensor would detect high levels of carbon monoxide or other abnormal gases in vehicle exhaust and even be integrated with vehicle electronic systems to notify drivers.

Infrared imaging: Thermographic camera Infrared imaging sensors include active and passive systems. For active sensing, IR imaging sensors typically scan a laser across the field of view of a scene and look for backscattered light at the absorption line wavelength of a specific target gas. Passive IR imaging sensors measure spectral changes at each pixel in an image and look for specific spectral signatures that indicate the presence of target gases. The types of compounds that can be imaged are the same as those that can be detected with infrared point detectors, but the images may be helpful in identifying the source of a gas.

Semiconductor: Semiconductor sensors detect gases by a chemical reaction that takes place when the gas comes in direct contact with the sensor. Tin dioxide is the most common material used in semiconductor sensors, and the electrical resistance in the sensor is decreased when it comes in contact with the monitored

gas. The resistance of the tin dioxide is typically around 50 k? in air but can drop to around 3.5 k? in the presence of 1% methane. This change in resistance is used to calculate the gas concentration.

Semiconductor sensors are commonly used to detect hydrogen, oxygen, alcohol vapor, and harmful gases such as carbon monoxide. One of the most common uses for semiconductor sensors is in carbon monoxide sensors. They are also used in breathalyzers. Because the sensor must come in contact with the gas to detect it, semiconductor sensors work over a smaller distance than infrared point or ultrasonic detectors.

Ultrasonic: Ultrasonic gas detectors use acoustic sensors to detect changes in the background noise of its environment. Since most high-pressure gas leaks generate sound in the ultrasonic range of 25 kHz to 10 MHz, the sensors are able to easily distinguish these frequencies from background acoustic noise which occurs in the audible range of 20 Hz to 20 kHz. The ultrasonic gas leak detector then produces an alarm when there is an ultrasonic deviation from the normal condition of background noise. Ultrasonic gas leak detectors cannot measure gas concentration, but the device is able to determine the leak rate of an escaping gas because the ultrasonic sound level depends on the gas pressure and size of the leak.

Holographic: Holographic gas sensors use light reflection to detect changes in a polymer film matrix containing a hologram. Since holograms reflect light at certain wavelengths, a change in their composition can generate a colorful reflection indicating the presence of a gas molecule.[12] However, holographic sensors require illumination sources such as white light or lasers, and an observer or CCD detector.

Connectivity

What factors define the connectivity solutions used to provide both device-to-device and device-to-cloud communication?

Wide Area Network (WAN)

Data Viewpoint

Data Sources

How is data obtained by the system?

Data is collected at compressor stations and other operational points.

Implementation Viewpoint

Business & Organizational Challenges

What business challenges could impact deployment?

Equipment failures in the compressor station can lead to loss of revenue.

IoT ONE Use Case

Accelerating the Industrial Internet of Things

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