Wireless Sensors in IoT

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The Internet of Things (IoT) is going to change our world. It is estimated that there will be nearly 22 billion IoT devices by 2025. Extending internet connectivity to everyday objects will transform industries and create tremendous cost savings. But how do non-internet-enabled devices gain connectivity capabilities? and the answer is through wireless sensors.

With wireless sensors, the IoT is possible. Individuals and organizations can use wireless sensors to enable many different kinds of smart applications. From interconnected homes to smart cities, wireless sensors create the infrastructure upon which the IoT comes alive.

1.1 What are wireless sensors?

Now lets see what is a wireless sensor A wireless sensor is a device that can gather sensory information and detect changes in local environments.

Sensors are designed to measure specific parameters about their physical surroundings and produce outputs, often electrical signals, for further processing. These parameters include many different types of stimuli, including air temperature, lighting levels, movements, and leakages.

Due to the fact that wireless sensors don't actually perform heavy data processing locally, they consume very little power and can last years on a single battery if an optimal wireless technology is used. Additionally, sensors are easily supported on low-speed networks as they transmit very light data loads.

1.2 Passive Sensors:

Passive sensors are self-powered devices that respond to inputs from surrounding environments. They don't actively probe and, therefore, do not require an external energy source. An example of a passive sensor would be Photodiode and thermistor as u can see another example for it can be a mercury-based thermometer that rises and falls with temperature but does not require external power.

1.3 Active Sensors:

Active sensors, on the other hand, rely on external power to continually monitor local environments. Examples of active sensors include devices that use radar or sonar in order to probe surroundings and a gieger tube to detect radiation.

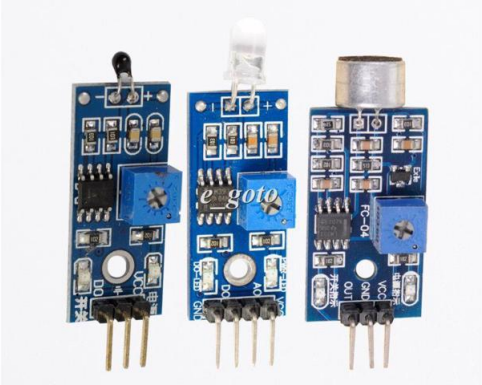

Figure 1.1: Photodiode, Thermistor, Sound Detection Sensors

2 Examples of Wireless Sensors

2.1 Wireless Movement Sensors:

Wireless movement sensors can detect certain types of motion, including acceleration and tilt. For example, wireless movement sensor alarms can be configured to alert owners when their valuable assets or packages are on the move. With acceleration-based sensors, companies can monitor the movement of assets or measure impact forces. PIR sensors are often used in security and people detection applications.

2.2 Wireless Air Sensors:

Wireless air sensors are used to assess air quality, including temperature, humidity, and the presence of harmful gases. Using wireless air temperature and humidity sensors, homeowners can detect heat system failures or measure humidity levels in greenhouses or in-home saunas. With air sensors, art gallery owners can carefully regulate room temperatures and restaurants can detect refrigeration failures before it's too late.

2.3 Wireless Temperature Sensors:

Wireless temperature sensors can not only track temperatures in the surrounding environment, but can also measure material temperatures. For example, probe-type temperature sensors can detect frozen pipes and warn homeowners that they need to take preemptive measures to avoid future problems. Warehouses will use air temp and humidity sensors measure heat index values to ensure the safety of their employees.

2.4 Wireless Optical Sensors:

Wireless optical sensors can detect optical events involving light levels or optical beam crossings. With light detection sensors, greenhouses can track solar and light levels throughout the day. Museums can configure light metering sensors to warn supervisors of when there is too much harmful UV radiation present.Wireless optical sensors can detect optical events involving light levels or optical beam crossings. With light detection sensors, greenhouses can track solar and light levels throughout the day. Museums can configure light metering sensors to warn supervisors of when there is too much harmful UV radiation present.

2.5 Wireless Proximity Sensors:

Wireless proximity sensors detect the presence or absence of different types of objects. There are several categories of proximity sensors that include inductive, ultrasonic, infrared, microwave, laser. Some of the most common proximity sensors use hall effect sensors or reed switches to detect the presence of a magnet.

2.6 Wireless Push Buttons:

Wireless push buttons transmit signals when buttons are pushed, which is particularly important in emergency health or personal situations.Wireless push button sensors can also be used in customer service settings when guests need to be able to request assistance.

2.7 Wireless Liquid Sensors:

Wireless liquid sensors detect the presence of liquids, such as water or fuel.Like for example, A flow sensor can monitor when water movement has stopped, indicating potentially frozen pipes.

3 Traditional Wireless Sensor Protocols

1. Wifi(Wireless Fidelity)
2. Bluetooth and BLE
3. Zigbee
4. Z-Wave

3.1 Wifi(Wireless Fidelity):

It is a widespread and versatile Local Area Network technology that sends information over two primary frequencies, 2.4GHz and 5GHz. WiFi networks can transfer large data packets at relatively fast speeds over medium ranges. The primary advantage of WiFi is its availability in most homes and businesses.

On the downside, connected devices consume a lot of power. Also, the management of the WiFi keys are in the local router which means that a change in a key can easily break sensors that were previously connected. And there is no simple means to update these keys.So Devices that have displays allow the user to easily change the key, but most simple sensors do not have this type of interface and require a provisioning process to modify the key. So this makes long-term management and reliability a problem for WiFi Sensors.Also, most IoT sensors don't typically need the bandwidth available with WiFi.

3.2 Bluetooth and BLE:

Defined in the category of Wireless Personal Area Networks, Bluetooth is a short-range communication technology well-positioned in the consumer marketplace. Optimized for power consumption, Bluetooth Low-Energy was later introduced to address small-scale Consumer IoT applications.

Bluetooth Low Energy, or BLE, is a low-power protocol that is designed to support periodic low data rate wireless communication over short ranges. Not to be confused with Bluetooth technology which is great for streaming audio to speakers or headsets. BLE is intended for wireless sensors

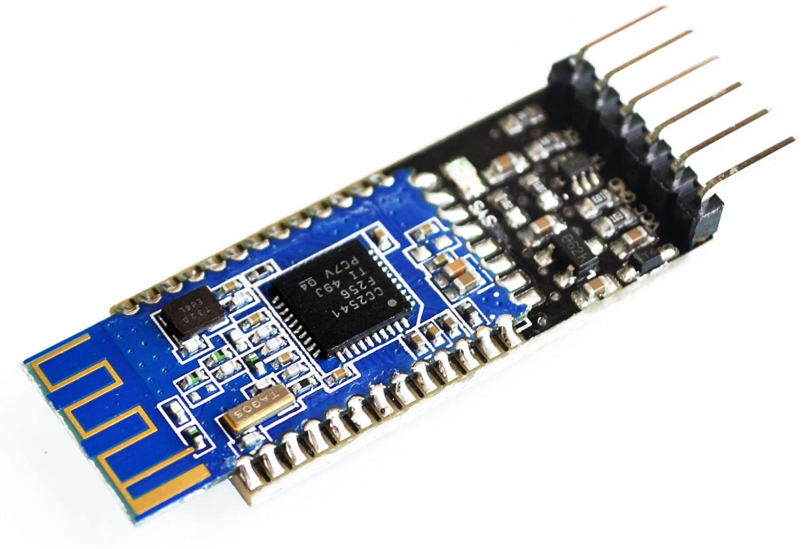

Figure 1.2: Bluetooth and BLE Module

that transmit small packets of information. The technology is a cost-effective alternative to WiFi that doesn't consume nearly as much power from devices.Below is a image of a bluetoth model HC-05 which can be used with arduino.

3.3 Zigbee:

For over a decade, Zigbee has served as a low-power alternative to Bluetooth and WiFi that is best suited for wireless sensors that don't require much bandwidth. The technology is built around the IEEE 802.15.4 standard and relies on mesh networks to transmit data. As a result, Zigbee is often used to enable smart homes consisting of many low-power devices. Typically, Zigbee is a perfect complement to Wi-Fi for various home automation.

3.4 Z-Wave:

Z-Wave is a wireless protocol designed specifically for smart home applications. Developed by Zensys, the technology is an alternative to Zigbee that runs on the "less noisy" 900MHz frequency band, thereby enabling it to avoid major interference issues. Z-Wave is used extensively in the home-security industry as it allows for bi-directional communications to end points through an encrypted channel. Traditional home security protocols are one-way only and unencrypted. Therefore, they don't work well for applications such as door locks.

New and Emerging LPWAN Standards for Wireless Sensors

LPWAN stands for Low Power Wide Area Network.In recent years, the movement to connect simple devices, like sensors, to the Internet and the vision to connect billions of everyday objects around the world, has led to a new class of wireless standards that are classified as low-power wide-area networks, or LPWANs. LPWANs are a specific class of radio technologies that are used to send small amounts of data over very long distances. This consume much less power from connected wireless sensors and are less costly to access.

Among these, LoRa, Sigfox, and NB-IoT are the most widely used and effective for supporting wireless sensors.Also, not all LPWANs are created equal. Today, there exist technologies operating in both the licensed and unlicensed spectrum with varying degrees of performance in key network factors.

4 Examples Of LPWAN Technologies:

1. Lora
2. Sigfox
3. NB-IOT

4.1 Lora:

LoRa(Long Range) it is a popular wireless standard with a higher bandwidth capacity than Sigfox. It uses a proprietary modulation scheme called chirp spread spectrum, which enables excellent link margins and can reach signals that are below the RF noise floor. Consequently, the sensors can transmit larger data packets through noisy environments over long distances.

4.2 Sigfox:

Sigfox It offers LPWAN coverage across the world, and uses ultra narrowband modulation to transmit very small packets of data. In the Sigfox model, there is no need to add your own gateway infrastructure because the wireless sensors communicate directly with Sigfox base stations.Sigfox is especially useful for simple sensors that only send infrequent and simple data packets. Due to the simplicity of the protocol, Sigfox hardware is extremely cost effective.

4.3 NB-IOT:

NB IOT (short for Narrowband IoT or NB1) is essentially the cellular carriers' answer to LPWAN. NB-IoT provides wide area coverage for low-power devices at a cost-effective rate. The standard leverages existing cell tower infrastructure and can operate on LTE base stations.Narrowband IoT can also work side-by-side with 3G and 4G networks. T-Mobile now offers NB-IoT coverage in markets where they have 4G coverage.

How does wireless sensor technology fit into Internet of Things?

The success of the Internet of Things is highly dependent on wireless sensor technology. Wireless sensors will enable many major IoT applications across a wide variety of sectors and settings. With such a vast array of sensors available, IoT possibilities are virtually endless.

Smart homes, smart buildings, smart cities, smart agriculture and supply chain management are just a few of the areas that will be dramatically impacted by wireless sensor networks. Lets see several specific use cases that demonstrate how versatile and important wireless sensors will be in the future.

Connecting Everyday objects in Smart Homes:

In a single home, residents may use a variety of wireless sensors to track surrounding conditions and bolster security. For example, a homeowner could install wireless door or window sensors throughout the house to monitor opening and closing events at all times. As u can see every time when the door will open there is a blink in the sensor .These same sensors can be used to detect activity around lock boxes and cabinets that hold valuables or private information. Homeowners can also install wireless dry contact sensors in doorbells or other remote control units throughout the house that send alerts when certain buttons are pushed.

Preserving and maintaining fragile artwork:

In museums and art galleries, preservation specialists can place wireless humidity sensors in rooms to monitor and adjust air conditions in order to protect artifacts or artwork. Optical sensors could also be used to detect lighting levels and ensure that guests have the best possible viewing experiences.

Supporting patient health care via real-time monitoring:

At senior care facilities, wireless push buttons are particularly important as they can be configured to act like mobile PERS devices that will warn staff when help is needed. Just like in smart homes, these facilities can also use wireless door or window sensors to detect when residents are trying to leave their rooms unattended.Some examples of IOt in healthcare industry are remote patient monitoring,improved drug management,chronic disease management and many more.

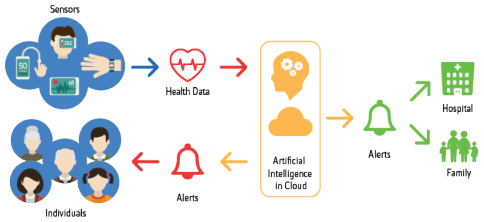

Figure 1.3: Health in IoT

Protecting and fixing local infrastructure :

It could also be useful in Protecting and fixing local infrastructure quickly Utility companies can install high-temperature probes on utility poles in order to detect transformer failures. With tilt sensors, they could also configure sensors to send alerts to maintenance personnel when poles are leaning or have been struck by vehicles.

Enabling a better and smarter Product Management :

In enabling better and smart product management where Grocery stores and retailers can protect assets with different types of wireless sensors located throughout their premises. With wireless air temperature sensors, facilities managers can track temperature levels in refrigeration units and

make sure that perishables are safe. By using wireless temperature sensors, they can also measure the temperature of refrigerated foods, thus creating an effective cold chain monitoring system. For those with large glass window displays, wireless vibration sensors can be extremely useful for detecting glass breaks instantly and warning the appropriate authorities.

Who provides wireless solutions?

A number of companies design wireless sensor solutions for IoT applications today.

Monnit creates remote monitoring solutions based on its proprietary protocol, Alta, and sells many components, including sensors, gateways, software, and other accessories. Tektelic is a supplier of sensors, applications, and gateways, and a developer of solutions for clients who are trying to launch IoT applications. Laird develops customized IoT platforms, wireless modules, and antenna solutions. Advantech provides a number of solutions around industrial IoT (IIoT).

All of these can be fine options if the product mix matches your requirements. Radio Bridge, however, is the only company exclusively focused on sensor products built upon these new and emerging wireless standards.