Unit 3


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Text A

IoT Protocols

1. MQTT

MQTT is a widely adopted security protocol in the realm of IoT security. MQTT, which stands for message queuing telemetry transport, is a client-server communication messaging transport protocol. It operates over TCP/IP or other protocols that offer reliable, lossless, and bidirectional connections.

Features of MQTT:

MQTT is a lightweight and straightforward protocol that facilitates rapid and efficient data transmission.It is specifically designed for use with constrained devices and networks that have low bandwidth, high latency, or unreliability.

The protocol's minimal use of data packets[1] results in reduced network usage, while its optimal power consumption helps to conserve the battery life of connected devices, making it an ideal choice for mobile phones and wearables.

MQTT is based on messaging techniques, which ensures fast and reliable communication. As such, it is well-suited for use in IoT applications.

Where is it used?

The security of MQTT is structured into distinct layers, namely the network, transport, and application levels, each of which serves to thwart a particular form of attack. Given that MQTT is a protocol that is lightweight in nature, it incorporates only a limited number of security mechanisms. To bolster security, MQTT implementations frequently leverage other security

1 A data packet is a unit of data made into a single package that travels along a given network path. Data packets are used in internet protocol (IP) transmissions for data that navigates the Web, and in other kinds of networks.

standards such as SSL[1]/TLS[2] for transport encryption, VPN at the network level to ensure a physically secure network, and the use of username/password. In addition, a client identifier is transmitted with data packets to authenticate devices at the application level.

2. CoAP

The constraint application protocol (CoAP) is a Web transfer protocol that has been specifically designed to cater to the requirements of constrained devices, such as microcontrollers, and the low power or lossy networks that they operate on. It is widely recognized as one of the most popular protocols for securing IoT applications.

Features of CoAP:

Like HTTP, it is founded on the REST architecture.

Clients utilize methods such as GET, PUT, POST, and DELETE to access resources provided by servers through URLs.

CoAP is specifically engineered to operate on microcontrollers. It is an ideal protocol for the internet of things, which necessitates millions of low-cost nodes.

CoAP is resource-efficient, which requires minimal resources on both the device and the network. It employs UDP on IP instead of a complex transport stack.

Where is it used?

The CoAP utilizes the UDP for information transportation and consequently depends on the security aspects of UDP to safeguard the information. CoAP employs datagram transport layer security (DTLS) over UDP for enhanced security.

CoAP has been developed with a straightforward and user-friendly interface that seamlessly integrates with HTTP for Web integration. It also offers features such as multicast support and low overhead concerns, thereby contributing to the security of the Internet of Things.

3. DTLS

The datagram transport layer security (DTLS) protocol is a security measure specifically developed for IoT to safeguard data communication between applications that rely on datagrams. DTLS is built on the foundation of the transport layer security (TLS) protocol and it offers an equivalent level of security.

The primary aim of DTLS is to address challenges such as data loss and reordering by making minor modifications to TLS. The DTLS protocol preserves the semantics of the underlying transport layer, thereby avoiding any delays caused by associated stream protocols. However, the application must handle issues such as datagram loss, packet reordering, and data exceeding the size of a datagram network packet.

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1 Secure sockets layer (SSL) is a security protocol that provides privacy, authentication, and integrity to Internet communications. SSL eventually evolved into transport layer security (TLS).

2 Transport layer security (TLS) is the most widely used security protocol for communications over the Internet. TLS provides three main functions: authentication, encryption, and verification. It encrypts transmissions using a system of certificates and keys, verifies both network entities are authorized to transmit/receive data, and ensures the data hasn't been corrupted.

Features of DTLS:

DTLS employs a retransmission timer to address the challenge of packet loss.

In the event that the timer expires prior to the client receiving the confirmation message from the server, the client will retransmit the data. To mitigate the issue of reordering, each message is assigned a unique sequence number, enabling the determination of whether the subsequent message received is in sequence or not. If it is out of sequence, it is placed in a queue and processed when the sequence number is attained.

Where is it used?

DTLS is commonly used in various applications, including live video feeds, video streaming, gaming, VoIP, and instant messaging. This protocol is particularly suitable for scenarios where low latency is of greater significance than data loss.

4. 6LoWPAN

The 6LoWPAN protocol, which stands for IPv6 over low power wireless personal area networks, is specifically designed for low-power networks such as wireless sensor networks and IoT systems.

Features of 6LoWPAN:

6LoWPAN is a protocol utilized for transmitting data packets in the form of IPv6 across diverse networks.It offers end-to-end IPv6 connectivity, thereby enabling direct access to a broad range of networks, including the Internet. Additionally, 6LoWPAN is employed to safeguard communications between end-users and sensor networks.

To ensure security in the IoT, 6LoWPAN utilizes AES-128 link layer security, as defined in IEEE 802.15.4. Link authentication and encryption are utilized to provide security, and further security is provided to transport layer security mechanisms that operate over TCP.

Where is it used?

6LoWPAN is a pivotal technology in various domains such as smart home automation, industrial monitoring, smart grids, and general automation.

5. ZigBee

ZigBee is widely regarded as a cutting-edge protocol that offers robust security for IoT devices and applications. This technology facilitates seamless machine-to-machine communication over distances ranging from 10 to 100 meters, making it ideal for low-powered embedded devices such as radio systems. Additionally, ZigBee is an open-source wireless technology that is both cost-effective and highly efficient.

Features of ZigBee:

ZigBee offers standardization across all layers, promoting compatibility among products from various manufacturers.Its mesh architecture facilitates connectivity with nearby devices, thereby expanding the network and enhancing its flexibility.

The implementation of “Green Power” by ZigBee results in reduced energy consumption

and cost. Additionally, ZigBee supports a high number of devices, approximately 6550, contributing to the scalability of networks.

Where is it used?

ZigBee is mainly used in home automation, medical data collection, industrial control systems, meter reading system, light control system, commercial, government markets worldwide, home networking, etc.

6. AMQP

AMPQ is a highly efficient, portable, and multichannel messaging protocol that prioritizes security. The protocol offers authentication and encryption through SASL[1] or TLS, which rely on a transport protocol like TCP.

Features of AMQP:

The AMQP protocol is developed with the aim of facilitating communication between a diverse range of applications and systems, regardless of their internal architecture. This has resulted in the standardization of business communications on an industrial scale.

Where is it used?

The protocol is utilized in client/server communication as well as in the management of IoT devices. AMPQ boasts of its efficiency, portability, multichannel capabilities, and security features.

7. DDS

DDS is a publish-subscribe protocol that differs from MQTT in that it does not require a server connection. Instead, DDS utilizes a brokerless architecture, resulting in a high-speed and high-performance protocol that is not reliant on any intermediary system. Developed by the object management group (OMG), DDS is specifically designed for device-to-device communications.

Features of DDS:

The DDS technology facilitates the creation of open architecture systems that are modular and loosely coupled.

It achieves this by enabling well-defined interfaces between subsystems and components, thereby eliminating the closed and proprietary architecture.

This approach reduces the costs associated with integration, maintenance, and upgrades, while promoting competition and ease of reuse at the middleware and subsystem levels.

Moreover, DDS standardizes messaging semantics, which enhances the system's robustness and reduces the overall development and integration costs.

Where is it used?

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1 Simple authentication and security layer (SASL) is a framework for authentication and data security in Internet protocols. It decouples authentication mechanisms from application protocols, in theory allowing any authentication mechanism supported by SASL to be used in any application protocol that uses SASL.

DDS caters to the real-time data exchange requirements of various applications in the aerospace, defense, air-traffic control, autonomous vehicles, medical devices, robotics, simulation and testing, smart grid management, transportation systems, and other related domains.

New Words

adopt	[ə'dɒpt]	*vt.* 采用，采取
realm	[relm]	*n.* 领域，范围
operate	['ɒpəreɪt]	*v.* 运行；操作
reliable	[rɪ'laɪəbl]	*adj.* 可靠的；可信赖的
lossless	['lɒsləs]	*adj.* 无损的；无损耗的
feature	['fiːtʃə]	*n.* 特征，特点
lightweight	['laɪtweɪt]	*adj.* 轻量的
straightforward	[ˌstreɪt'fɔːwəd]	*adj.* 明确的
facilitate	[fə'sɪlɪteɪt]	*vt.* 促进；使容易；帮助
bandwidth	['bændwɪdθ]	*n.* 带宽
latency	['leɪtənsɪ]	*n.* 延迟
unreliability	[ˌʌnrɪˌlaɪə'bɪlətɪ]	*n.* 不安全性，不可靠性
wearable	['weərəbl]	*adj.* 可穿用的，可佩戴的
transport	['trænspɔːt]	*vt.* 传输，运输
attack	[ə'tæk]	*v.* & *n.* 攻击，进攻
incorporate	[ɪn'kɔːpəreɪt]	*vi.* 合并；混合
bolster	['bəʊlstə]	*vt.* 支持，支撑
username	['juːzəneɪm]	*n.* 用户名
password	['pɑːswɜːd]	*n.* 密码；口令
client	['klaɪənt]	*n.* 客户，客户端
identifier	[aɪ'dentɪfaɪə]	*n.* 标识符
authenticate	[ɔː'θentɪkeɪt]	*vt.* 验证
recognize	['rekəgnaɪz]	*vt.* 识别；承认
safeguard	['seɪfgɑːd]	*n.* & *vt.* 保护，保卫；防护
enhance	[ɪn'hɑːns]	*vt.* 增强，加强；提高
seamlessly	['siːmləslɪ]	*adv.* 无缝地
integrate	['ɪntɪgreɪt]	*v.* 集成，合并；成为一体
equivalent	[ɪ'kwɪvələnt]	*adj.* 相等的，相当的，等效的；等价的 *n.* 对等物
modification	[ˌmɒdɪfɪ'keɪʃn]	*n.* 修改，修正，变更
delay	[dɪ'leɪ]	*n.* 延迟
stream	[striːm]	*n.* 流
timer	['taɪmə]	*n.* 定时器，计时器

confirmation	[ˌkɒnfə'meɪʃn]	*n.* 确认；证实
determination	[dɪˌtɜːmɪ'neɪʃn]	*n.* 确定
subsequent	['sʌbsɪkwənt]	*adj.* 后来的；随后的
attain	[ə'teɪn]	*vi.* 获得；达到
wireless	['waɪələs]	*adj.* 无线的
end-to-end	[endtuːend]	*adj.* 端到端的
pivotal	['pɪvətl]	*adj.* 关键的；中枢的
general	['dʒenrəl]	*adj.* 通用的，普遍的
cutting-edge	['kʌtɪŋ 'edʒ]	*adj.* 前沿的
robust	[rəʊ'bʌst]	*adj.* 强健的；坚固的，结实的
radio	['reɪdɪəʊ]	*n.* 无线电
open-source	['əʊpən sɔːs]	*adj.* 开源的，提供源程序的
standardization	[ˌstændədaɪ'zeɪʃn]	*n.* 标准化；规范化
portable	['pɔːtəbl]	*adj.* 轻便的；手提的
multichannel	['mʌltɪtʃænl]	*adj.* 多通道；多通路；多波段的
brokerless	['brəʊkəles]	*adj.* 无代理的
intermediary	[ˌɪntə'miːdɪəri]	*adj.* 中间的
subsystem	['sʌb'sɪstəm]	*n.* 子系统，分系统
simulation	[ˌsɪmju'leɪʃn]	*n.* 模拟
robotic	[rəʊ'bɒtɪk]	*adj.* 机器人的；自动的

Phrases

bidirectional connection	双向连接
data transmission	数据传输
constrained device	受限设备，受限装置
data packet	数据包
power consumption	能量消耗；耗电量
be structured into	被组织成，被构造为
security mechanism	安全机制
application level	应用层
low-cost node	低成本节点
user-friendly interface	用户友好界面
unique sequence number	唯一序列号
instant messaging	即时通信（服务），即时信息传输
be suitable for ...	适合……的
link layer	链路层
industrial monitoring	工业监测
smart grid	智能电网

be regarded as	被认为
industrial control system	工业控制系统
home networking	家庭联网
client/server communication	客户端/服务器通信
open architecture system	开放体系系统
air-traffic control	空中交通管制
autonomous vehicle	自动驾驶车辆
medical device	医疗设备
transportation system	运输系统

Abbreviations

MQTT (Message Queuing Telemetry Transport)	消息队列遥测传输
TCP/IP (Transmission Control Protocol/Internet Protocol)	传输控制协议/网际协议
SSL (Secure Socket Layer)	安全套接字层
TLS (Transport Layer Security)	传输层安全协议
VNN (Virtual Native Network)	虚拟专用网
CoAP (Constraint Application Protocol)	约束应用程序协议
HTTP (Hypertext Transfer Protocol)	超文本传输协议
REST (Representational State Transfer)	描述性状态转移
DTLS (Datagram Transport Layer Security)	数据报传输层安全
VoIP (Voice over Internet Protocol)	互联网电话
6LoWPAN (IPv6 over Low Power Wireless Personal Area Networks)	低功耗无线个人区域网上的 IPv6
IEEE (Institute of Electrical and Electronics Engineers)	电气电子工程师学会
AMQP (Advanced Message Queuing Protocol)	高级消息队列协议
SASL (Simple Authentication and Security Layer)	简单身份验证和安全层
DDS (Data Distribution Service)	数据分发服务
OMG (Object Management Group)	对象管理组

Analysis of Difficult Sentences

[1] MQTT, which stands for message queuing telemetry transport, is a client-server communication messaging transport protocol.

本句中，which stands for message queuing telemetry transport 是一个非限定性定语从句，对 MQTT 进行补充说明。

[2] The security of MQTT is structured into distinct layers, namely the network, transport, and application levels, each of which serves to thwart a particular form of attack.

本句中，namely the network, transport, and application levels 对 distinct layers 进行补充说明。each of which serves to thwart a particular form of attack 是一个非限定性定语从句，也

对 distinct layers 进行补充说明。

英语中，名词/代词/数词+of+which / whom 可以引导一个非限定性定语从句。例如：

Peter bough several books, five of which were on management.

皮特买了一些书，其中 5 本是管理方面的。

I bought a new mobile phone online last week, the price of which was very reasonable.

我上周在网上买了一部新手机，价格很合理。

Our manager has a lot of friends, some of whom are very famous businessmen.

我们经理有许多朋友，其中一些是非常著名的商界人士。

[3] The constraint application protocol (CoAP) is a Web transfer protocol that has been specifically designed to cater to the requirements of constrained devices, such as microcontrollers, and the low power or lossy networks that they operate on.

本句中，that has been specifically designed to cater to the requirements of constrained devices, such as microcontrollers, and the low power or lossy networks that they operate on 是一个定语从句，修饰和限定 a Web transfer protocol。在该从句中，such as microcontrollers 是对 constrained devices 的举例说明。that they operate on 是一个定语从句，修饰和限定 the low power or lossy networks。

[4] The datagram transport layer security (DTLS) protocol is a security measure specifically developed for the IoT to safeguard data communication between applications that rely on datagrams.

本句中，specifically developed for IoT to safeguard data communication between applications that rely on datagrams 是一个过去分词短语，作定语，修饰和限定 a security measure。to safeguard data communication between applications that rely on datagrams 是一个动词不定式短语，作目的状语，修饰 developed。

[5] DDS is a publish-subscribe protocol that differs from MQTT in that it does not require a server connection.

本句中，that differs from MQTT in that it does not require a server connection 是一个定语从句，修饰和限定 a publish-subscribe protocol。在该从句中，in that it does not require a server connection 是一个原因状语从句，修饰谓语 differs from。

Exercises

【EX.1】Answer the following questions according to the text.

1. What does MQTT stand for? What is it?
2. What is MQTT specifically designed for?
3. What is CoAP widely recognized as?
4. What is the datagram transport layer security (DTLS) protocol?
5. Where is DTLS commonly used?
6. What is the 6LoWPAN protocol specifically designed for?
7. What is ZigBee widely regarded as?

8. Where is ZigBee used?
9. What is the aim that the AMQP protocol is developed with?
10. What does the DDS technology facilitate?

【EX.2】 Translate the following terms or phrases from English into Chinese and vice versa.

1.	attack	1.	
2.	bandwidth	2.	
3.	client	3.	
4.	delay	4.	
5.	enhance	5.	
6.	feature	6.	
7.	identifier	7.	
8.	lossless	8.	
9.	multichannel	9.	
10.	application level	10.	
11.	双向连接	11.	
12.	数据包	12.	
13.	链路层	13.	
14.	智能电网	14.	
15.	*n*. 模拟	15.	

【EX.3】 Translate the following sentences into Chinese.

1. Over time, the technology is diffused and adopted by other countries.
2. In the event of the machine not operating correctly, an error code will appear.
3. They need a reliable method to decrease the failure rate.
4. This model embodies many new features.
5. How to reduce the consumption of network bandwidth is a hot point in P2P network research.
6. It’s no wonder that new applications for the IoT are moving ahead fast when almost every new device we buy has a plug on the end of it or a wireless connection to the internet.
7. He conceived of the first truly portable computer in 1968.
8. Most smart home technology and devices are wireless.
9. Power management is one of the most important keys for lower power design of wearable computing system.
10. Each computer on a network must have a unique identifier.

【EX.4】Complete the following passage with appropriate words in the box.

transmitter	switch	installed	receive	plugged
standardize	convey	entertainment	smart	coded

A smart home or building is a home or building, usually a new one, that is equipped with special structured wiring to enable occupants to remotely control or program an array of automated home electronic devices by entering a single command. For example, a homeowner on vacation can use a Touchtone phone to arm a home security system, control temperature gauges, ___1___ appliances on or off, control lighting, program a home theater or entertainment system, and perform many other tasks.

The field of home automation is expanding rapidly as electronic technologies converge. The home network encompasses communications, ___2___, security, convenience, and information systems.

A technology known as powerline carrier systems (PCS) is used to send ___3___ signals along a home's existing electric wiring to programmable switches, or outlets. These signals ___4___ commands that correspond to "addresses" or locations of specific devices, and that control how and when those devices operate. A PCS ___5___, for instance, can send a signal along a home's wiring, and a receiver plugged into any electric outlet in the home could ___6___ that signal and operate the appliance to which it is attached.

One common protocol for PCS is known as X10, a signaling technique for remotely controlling any device ___7___ into an electrical power line. X10 signals, which involve short radio frequency (RF) bursts that represent digital information, enable communication between transmitters and receivers.

In Europe, technology to equip homes with ___8___ devices centers on development of the European Installation Bus, or Instabus. This embedded control protocol for digital communication between smart devices consists of a two-wire bus line that is ___9___ along with normal electrical wiring. The Instabus line links all appliances to a decentralized communication system and functions like a telephone line over which appliances can be controlled. The European Installation Bus Association is part of Konnex, an association that aims to ___10___ home and building networks in Europe.

【EX.5】Translate the following passage into Chinese.

What Is a "Smart House"?

A smart house is a house that has highly advanced automatic systems for lighting, temperature control, multi-media, security, window and door operations, and many other functions.

A smart home appears "intelligent" because its computer systems can monitor so many aspects of daily living. For example, the refrigerator may be able to inventory its contents,

suggest menus, recommend healthy alternatives, and order groceries. The smart home systems might even take care of cleaning the cat's litter box and watering the plants.

However, smart home technology is real, and it's becoming increasingly sophisticated. Coded signals are sent through the home's wiring to switches and outlets that are programmed to operate appliances and electronic devices in every part of the house. Home automation can be especially useful for elderly and disabled persons who wish to live independently.


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Text B

IoT Sensors

Sensors are devices that respond to inputs from the physical world and then take those inputs and display them, transmit them for additional processing, or use them in conjunction with artificial intelligence to make decisions or adjust operating conditions. When applied to the Industrial IoT, data collected from sensors is used to help business owners and managers make intelligent decisions about their operations, and help users use the business' products and services more efficiently.

As the IoT initiative expands, more and more sensors are going to be used to monitor and collect data for analysis and processing.

Sensors are designed to respond to specific types of conditions in the physical world, and then generate a signal (usually electrical) that can represent the magnitude of the condition being monitored. Those conditions may be light, heat, sound, distance, pressure, or some other more specific situation, such as the presence or absence of a gas or liquid.

1. Temperature Sensors

Temperature sensors detect the temperature of the air or a physical object and convert that temperature level into an electrical signal that can accurately reflect the measured temperature. These sensors can monitor the temperature of the soil to help with agricultural output or the temperature of a bearing operating in a critical piece of equipment to sense when it might be overheating or nearing the point of failure.

2. Pressure Sensors

Pressure sensors measure the pressure or force per unit area applied to the sensor and can detect things such as atmospheric pressure, the pressure of a stored gas or liquid in a sealed system such as tank or pressure vessel, or the weight of an object.

3. Motion Sensors

Motion sensors or detectors can sense the movement of a physical object by using any one

of several technologies, including passive infrared (PIR)[1], microwave detection, or ultrasonic, which uses sound to detect objects. These sensors not only can be used in security and intrusion detection systems, but also can be used to automate the control of doors, sinks, air conditioning and heating, or other systems.

4. Level Sensors

A level sensor is a device used to determine the liquid level flowing in an open or closed system. Liquid level measurement can be divided into two types: continuous measurement and point level measurement. Continuous liquid level sensors are used to accurately measure liquid levels, but the measurement results are correct. The point level sensor is used to determine whether the liquid level is high or low. It is designed to indicate whether the liquid has reached a specific point in the container. For example, a fuel gauge displays the level of fuel in a vehicle's tank and provides a continuous level reading. Some automobiles have a light that illuminates when the fuel level tank is very close to empty, acting as an alarm that warns the driver that fuel is about to run out completely.

5. Image Sensors

Image sensors function to capture images to be digitally stored for processing. Examples are license plate readers as well as facial recognition[2] systems. Automated production lines can use image sensors to detect issues with quality such as how well a surface is painted after leaving the spray booth.

6. Proximity Sensors

Proximity sensors can detect whether an object is approaching the sensor through various technologies.

These technologies include:

- Inductive technologies, which are useful for the detection of metal objects.
- Capacitive technologies, which function on the basis of objects having a different dielectric constant than that of air.
- Photoelectric technologies, which rely on a beam of light to illuminate and reflect back from an object, or
- Ultrasonic technologies, which use a sound signal to detect an object nearing the sensor.

7. Water Quality Sensors

The importance of water to human beings on earth is not only for drinking but as a key ingredient needed in many production processes. So it is necessary to sense and measure water

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1 A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. PIR sensors are commonly used in security alarms and automatic lighting applications.

2 Facial recognition uses technology and biometrics — typically through AI — to identify human faces. It maps facial features from a photograph or video and then compares the information with a database of known faces to find a match.

quality parameters. Some examples of what can be sensed and monitored include:

- Chemical presence (such as chlorine levels or fluoride levels).
- Oxygen levels (which may impact the growth of algae and bacteria).
- Electrical conductivity (which can indicate the level of ions present in water).
- PH level (a reflection of the relative acidity or alkalinity of the water).
- Turbidity levels (a measurement of the amount of suspended solids in water).

8. Chemical Sensors

Chemical sensors are designed to detect the presence of specific chemical substances. They are often used in production process analysis and environmental pollution monitoring. They are also applied in mineral resources detection, meteorological observation and telemetry, industrial automation, medical distance diagnosis and real-time monitoring, agricultural fresh preservation and fish detection, anti-theft, safety alarm and energy saving.

9. Gas Sensors

Related to chemical sensors, gas sensors are tuned to detect the presence of combustible, toxic, flammable gas in the vicinity of the sensor. Examples of specific gases that can be detected include:

- Bromine
- Carbon monoxide
- Chlorine
- Chlorine dioxide
- Ethylene
- Ethylene oxide
- Formaldehyde
- Hydrazine(s)
- Hydrogen
- Hydrogen bromide
- Hydrogen chloride
- Hydrogen cyanide
- Hydrogen peroxide
- •Hydrogen sulfide
- Nitric oxide
- Nitrogen dioxide
- Ozone
- Peracetic acid
- Propylene oxide
- Sulfur dioxide

10. Smoke Sensors

Smoke sensors or detectors pick up the presence of smoke conditions, which could be an indication of a fire typically, using optical sensors (photoelectric detection) or ionization detection.

11. Infrared (IR) Sensors

Infrared sensor technologies detect infrared radiation that is emitted by objects. Non-contact thermometers make use of these types of sensors as a way of measuring the temperature of an object without having to directly place a probe or sensor on that object. They are used in analyzing the heat signature of electronics and detecting blood flow or blood pressure in patients.

12. Acceleration Sensors

While motion sensors detect movement of an object, acceleration sensors detect the rate of change of velocity of an object. According to the different sensitive components of sensors, common acceleration sensors include capacitive sensors, inductive sensors, strain sensors, piezoresistive sensors, piezoelectric sensors, etc.

13. Gyroscopic Sensors

Gyroscopic sensors measure the rotation of an object and determine the rate of its movement called the angular velocity by using a 3-axis system. These sensors enable the determination of the object's orientation without having to visibly observe it.

14. Humidity Sensors

Humidity sensors are used to measure and monitor the amount of water present in the surrounding air. These sensors are widely used in industries such as semiconductor, biomedical, textiles, food processing, pharmaceuticals, meteorology, microelectronics, agriculture, structural health monitoring, and environment monitoring.

15. Optical Sensors

Optical sensors respond to light that is reflected from an object and generate a corresponding electrical signal. These sensors work by either sensing the interruption of a beam of light or its reflection caused by the presence of the object. Optical sensors include the following types:

- Through-beam sensors (which detect objects by the interruption of a light beam as the object crosses the path between a transmitter and remote receiver).
- Retro-reflective sensors (which combine transmitter and receiver into a single unit and use a separate reflective surface to bounce the light back to the device).
- Diffuse reflection sensors (which operate similarly to retro-reflective sensors except that the object being detected serves as the reflective surface).

New Words

respond [rɪ'spɒnd] *v.* 响应；回答

initiative	[ɪ'nɪʃətɪv]	*n.* 主动性；主动精神；倡议 *adj.* 主动的；自发的；创始的
magnitude	['mægnɪtjuːd]	*n.* 量级
pressure	['preʃə]	*n.* 压力；压强
overheat	[ˌəʊvə'hiːt]	*v.* 过度加热；（使）变得过热 *n.* 过热
ultrasonic	[ˌʌltrə'sɒnɪk]	*adj.* 超声的；超声波的，超声速的 *n.* 超声波
container	[kən'teɪnə]	*n.* 容器
alarm	[ə'lɑːm]	*n.* 警报；闹铃
capacitive	[kə'pæsɪtɪv]	*adj.* 电容性的
illuminate	[ɪ'luːmɪneɪt]	*vt.* 照亮，照明
ingredient	[ɪn'griːdɪənt]	*n.*（混合物的）组成部分；原料；要素
parameter	[pə'ræmɪtə]	*n.* 参数，参量
chlorine	['klɔːriːn]	*n.* 氯
fluoride	['flɔːraɪd]	*n.* 氟化物
algae	['ældʒiː]	*n.* 藻类
bacteria	[bæk'tɪərɪə]	*n.* 细菌（bacterium 的名词复数）
ion	['aɪən]	*n.* 离子
acidity	[ə'sɪdəti]	*n.* 酸性
alkalinity	[ˌælkə'lɪnəti]	*n.* 碱性
combustible	[kəm'bʌstəbl]	*adj.* 易燃的，可燃的
toxic	['tɒksɪk]	*adj.* 有毒的，中毒的 *n.* 毒物，毒剂
flammable	['flæməbl]	*adj.* 易燃的，可燃的
vicinity	[və'sɪnəti]	*n.* 附近，邻近
bromine	['brəʊmiːn]	*n.* 溴
formaldehyde	[fɔː'mældɪhaɪd]	*n.* 甲醛；福尔马林
ozone	['əʊzəʊn]	*n.* 臭氧
detector	[dɪ'tektə]	*n.* 探测器，检测器
photoelectric	[ˌfəʊtəʊɪ'lektrɪk]	*adj.* 光电的
ionization	[ˌaɪənaɪ'zeɪʃn]	*n.* 离子化，电离
radiation	[ˌreɪdɪ'eɪʃn]	*n.* 辐射，放射物
signature	['sɪgnətʃə]	*n.* 识别标志，鲜明特征；签名，署名
rotation	[rəʊ'teɪʃn]	*n.* 旋转，转动
semiconductor	[ˌsemɪkən'dʌktə]	*n.* 半导体
biomedical	[ˌbaɪəʊ'medɪkl]	*adj.* 生物医学的
textile	['tekstaɪl]	*n.* 纺织品，织物；纺织业

pharmaceutical	[ˌfɑːmə'suːtɪkl]	*adj*. 制药的，配药的
meteorology	[ˌmiːtɪə'rɒlədʒi]	*n*. 气象学
microelectronic	[ˌmaɪkrəʊɪˌlek'trɒnɪk]	*adj*. 微电子学的
interruption	[ˌɪntə'rʌpʃn]	*n*. 中断

Phrases

collect data	收集数据
in conjunction with	与……协作
Industrial IoT	工业物联网
temperature sensor	温度传感器
electrical signal	电信号
pressure sensor	压力传感器
atmospheric pressure	大气压力
pressure vessel	压力容器
motion sensor	运动传感器
microwave detection	微波探测
level sensor	液面传感器，液面监测器
closed system	封闭系统
fuel gauge	燃油表
image sensor	图像传感器
license plate	车牌，号码牌
facial recognition	面部识别，人脸识别
proximity sensor	接近传感器
dielectric constant	电容率；介电常数；介质常数
beam of light	光束
electrical conductivity	电导率
turbidity level	浊度
suspended solid	悬浮固体
chemical sensor	化学传感器
chemical substance	化学物质
environmental pollution	环境污染
real-time monitoring	实时监控
fresh preservation	保鲜
gas sensor	气体传感器
carbon monoxide	一氧化碳
chlorine dioxide	二氧化氯
ethylene oxide	环氧乙烷
hydrogen bromide	溴化氢

hydrogen cyanide	氢氰酸
hydrogen peroxide	过氧化氢
hydrogen sulfide	氢化硫
nitric oxide	一氧化氮
peracetic acid	过醋酸，过乙酸
propylene oxide	环氧丙烷
sulfur dioxide	二氧化硫
smoke sensor	烟雾传感器
optical sensor	光学传感器，光敏元件
infrared sensor	红外传感器
blood pressure	血压
acceleration sensor	加速度传感器
capacitive sensor	电容传感器
inductive sensor	感应传感器
strain sensor	应变感传器
piezoresistive sensor	压阻传感器
piezoelectric sensor	压电传感器
gyroscopic sensor	陀螺仪传感器
angular velocity	角速度
humidity sensor	湿度传感器
environment monitoring	环境监测
through-beam sensor	直通波束传感器
retro-reflective sensor	镜面反射型传感器
diffuse reflection sensor	漫反射传感器
reflective surface	反射面

Abbreviations

PIR (Passive Infrared)	被动红外技术
PH (Pondus Hydrogenii)	酸碱度

Exercises

【EX.6】Answer the following questions according to the text.

1. What are sensors?
2. What are sensors designed to do?
3. What do pressure sensors do?
4. What can motion sensors or detectors do?
5. What is a level sensor?
6. What are some examples of what can be sensed and monitored by water quality sensors?

7. What are gas sensors tuned to do?
8. What do infrared sensor technologies do?
9. What are humidity sensors used to do?
10. What types do optical sensors include?

【EX.7】Translate the following terms or phrases from English into Chinese and vice versa.

1.	detector	1.	
2.	interruption	2.	
3.	real-time monitoring	3.	
4.	parameter	4.	
5.	photoelectric	5.	
6.	semiconductor	6.	
7.	acceleration sensor	7.	
8.	angular velocity	8.	
9.	capacitive sensor	9.	
10.	collect data	10.	
11.	电信号	11.	
12.	面部识别，人脸识别	12.	
13.	感应传感器	13.	
14.	红外传感器	14.	
15.	光学传感器，光敏元件	15.	

【EX.8】Translate the following sentences into Chinese.

1. An ultrasonic sensor with a battery is put on the back of the glove.
2. We' re going to use the money to develop a smaller and lighter ultrasonic sensor.
3. The material is stored in a special radiation proof container.
4. Open system allows users to modify system parameters and initial parameters.
5. Infrared detectors have many uses.
6. Therefore, a various kinds of photoelectric devices have been developed.
7. How do we know that the signature is contemporaneous with the document?
8. Semiconductor devices can perform a variety of control functions in electronic equipment.
9. This paper proposes the method in high-level design of an embedded system interruption controller.
10. The simulation results show validity of presented method for compensating the rotation motion.

Reading Material

IoT Devices

1. What Are IoT Devices, Anyway?

An IoT device is any piece of physical hardware (a "thing," if you will) that's programmed to transmit data over the internet or other networks. IoT technology is often integrated with physical objects, like sensors and appliances. It can also be embedded directly into hardware such as industrial equipment, mobile devices, and other IoT devices.

IoT devices collect data from their environment — things like temperature, heart rate[1], etc.— and exchange that information with other devices and systems in an ecosystem. An IoT-enabled thermostat can detect the room temperature and adjust the heating or air conditioning appropriately, for example. As such, IoT devices create a new dimension[2] of interactions between people and the everyday objects that make up their environment.

2. Three Key Capabilities of IOT Devices

- Sensing — the device has sensors that detect events, changes and conditions in the physical environment like temperature, motion, pressure, location, etc.
- Connectivity — the device can connect to and exchange data over wired or wireless networks. This may be via WiFi, Bluetooth, cellular, satellite or other communication protocols.
- Data exchange — the device can send sensor data over networks and in some cases also receive data and commands to actuators that can control mechanisms and systems.

3. The Core Components of an IoT Device

- Sensors and actuators — sensors and actuators detect events and conditions and enable responses. Sensors convert physical properties into electrical signals[3]. Actuators convert electrical signals into physical actions.
- Processors — processors execute code that processes sensor data and controls actuators. They range from basic microcontrollers to advanced microprocessors and systems-on-chip[4].
- Communication hardware — communication hardware is connected to wired and wireless networks. It include chips, antennas, ports, etc.
- Software — the device has firmware and applications to manage device operation, data exchange protocols, process data and enable communication.

Operating system — some devices have compact real-time operating systems suited for IoT devices.

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1 heart rate：心率

2 dimension [daɪ'menʃn] *n.* 维度

3 electrical signal：电子信号

4 systems-on-chip：片载系统，片上系统

- Security features — the device has hardware and software to secure device communications and data transmissions.
- Power supply — the device has battery, power harvesting or AC power connection.

IoT devices take input from the physical world through sensors, process it and transmit it over networks. The connectivity allows them to exchange data with applications, services, other devices and users to enable useful functions.

4. How Do IoT Devices Work?

The basic function of any IoT device, regardless of the context or application, can be boiled down to[1] one fundamental goal: to collect data and share it across a network. Here's how that works.

IoT devices are connected to a network.In this way, they can communicate and interact with each other without actually establishing a physical connection. The network they communicate with may include cellular, satellite, WiFi, Bluetooth, low power wide area networks (LPWAN)[2], or an ethernet cable. The most popular networks used, however, are WiFi and Bluetooth. Some devices are accessible directly over the public internet, but the majority are integrated over a local private network for security purposes.

Data is collected by the devices and sent over the network to an IoT gateway or other edge device for centralized data storage. Depending on the application, that might look like reading air quality from a pollution sensor or recording a live video for a smart security system, for example.

Next, the data is analyzed locally on the centralized device, or sent to the cloud for processing. At this point, the centralized device can synchronize the behavior of the other edge devices in the network, or orchestrate[3] complex actions like making decisions based on what's happening to the system as a whole. An example of this is turning on all of the lights outside when motion is detected from a single sensor, or calling emergency services when an edge device sends a specific signal.

Finally, the data is made available to the end user in a way that's easily understood (if the interface is designed well). That could look like receiving live video feeds directly to your phone from a remote monitoring camera, or getting a text alert when temperatures get too high in a certain area.

5. The Benefits of IoT Devices

IoT devices are designed to make life easier and to make processes more intelligent. The benefits of integrating IoT devices into your business are many, including:

- Automation and control over otherwise manual data collection and processes.

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1 be boiled down to：归结为

2 low power wide area networks：低功耗广域网

3 orchestrate ['ɔ:kɪstreɪt] *vt*. 协调