


Introduction to IoT

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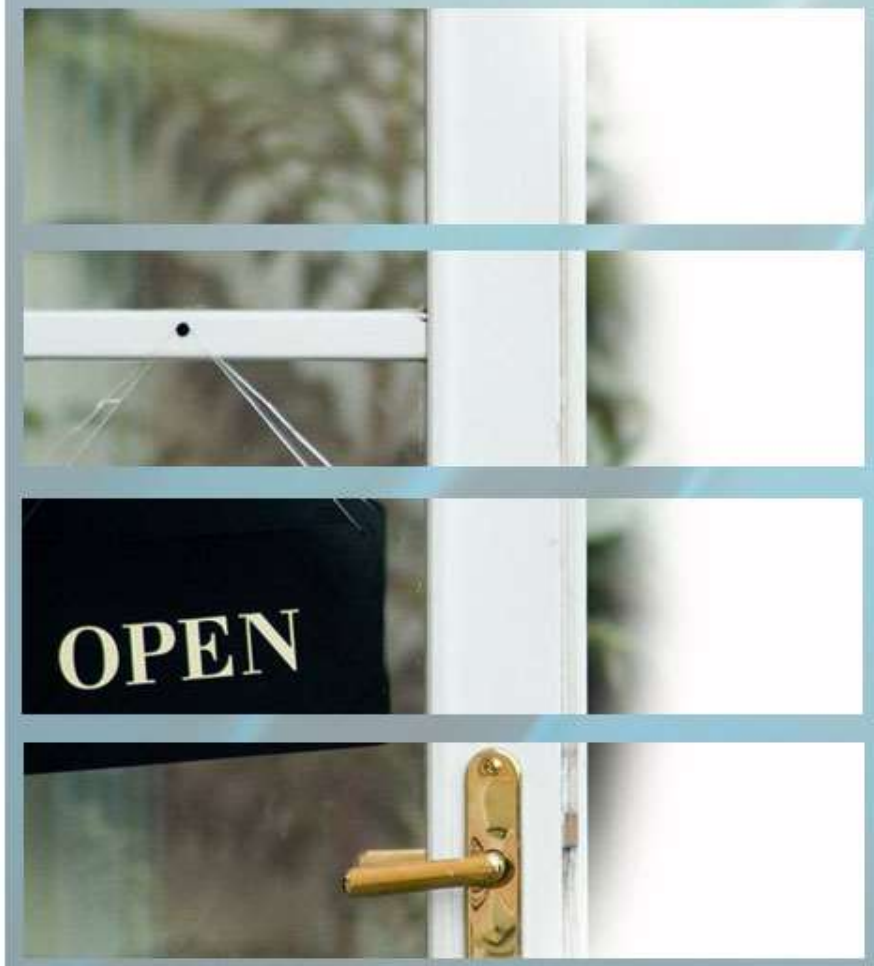
Chapter Two

Automatic identification technology and RFID

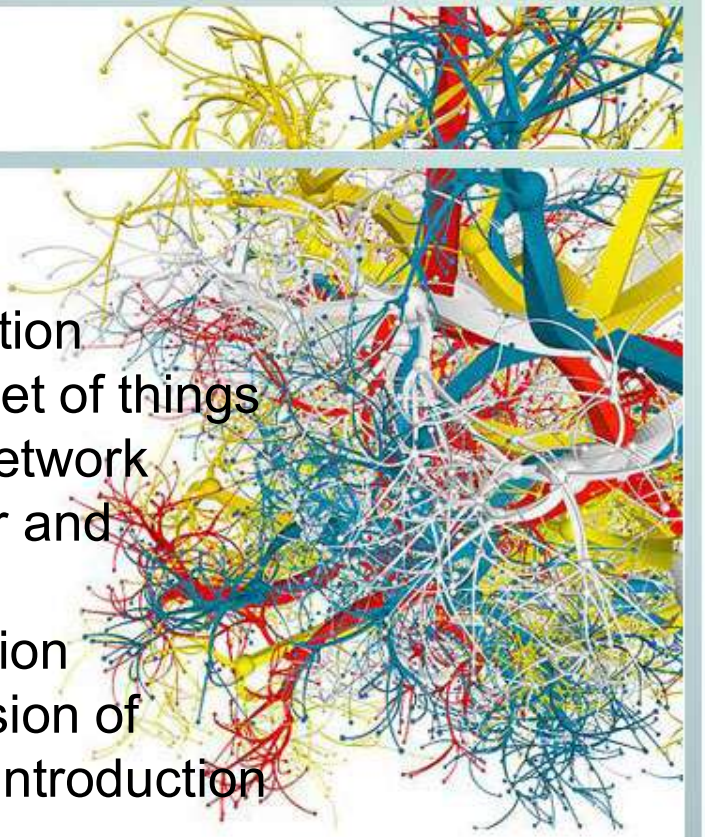


The most unique part of the Internet of things is that it combines the physical world and information world.

This chapter starts with **Automatic Identification Technology** and **RFID,** and introduces various information generation methods one by one.

Content

Review



•Chapter 1 introduces the basic concepts, core technologies, main features and application prospects of the Internet of things. The Internet of things is divided into four layers: perception layer, network construction layer, management service layer and comprehensive application layer.

•This chapter introduces automatic identification technology and RFID, focuses on the discussion of RFID composition, classification, and a brief introduction to prevent RFID tag conflict algorithm.

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2.1 Automatic identification technique

2.2 The history and current situation of RFID

2.3 RFID technical analysis

2.4 RFID tag conflict *

2.5 RFID and the Internet of things

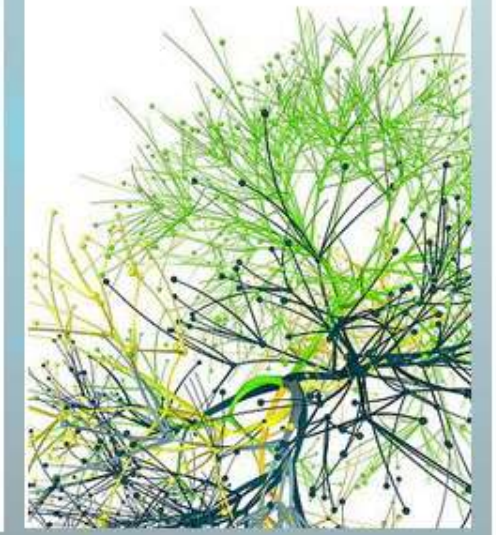
Automatic recognition technology is a typical application of pattern recognition theory.

- Optical Character recognition & speech recognition

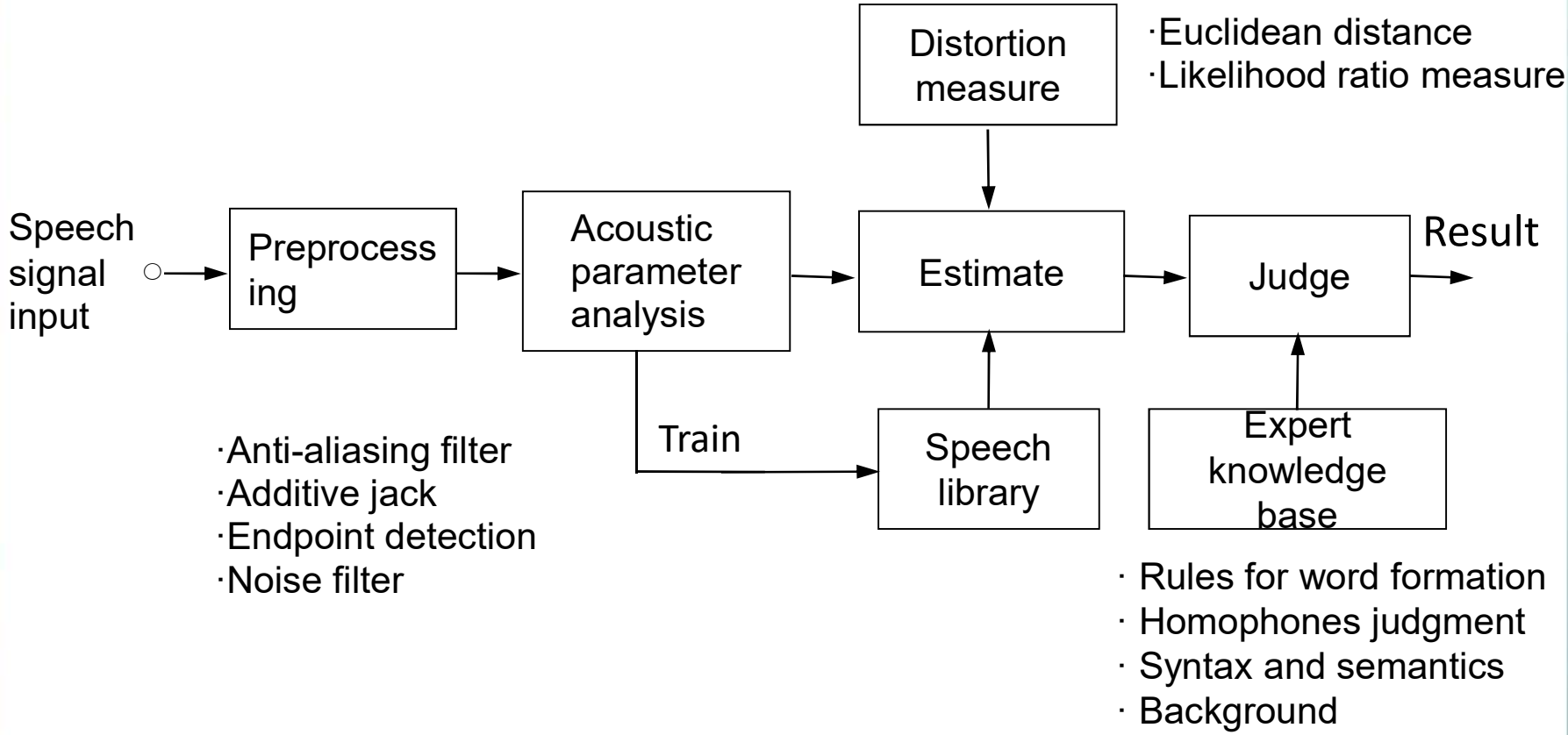
Optical Character Recognition(ORC)

A technique for Pattern Recognition (PR) that is designed to let a computer know exactly what it is seeing, especially text materials. OCR technology enables devices to recognize characters through optical mechanisms.

Speech recognition studies how to use digital signal processing technology to automatically extract and determine the most basic and meaningful information in language signals.



Speech recognition framework: a typical pattern recognition system

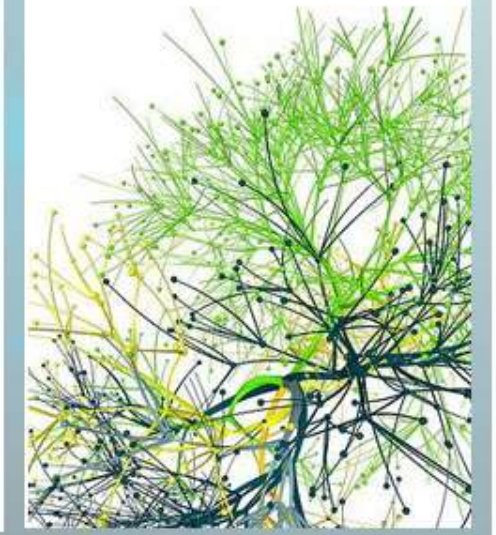


Iris recognition: appropriate biometric characteristics

Iris recognition is currently the most convenient and accurate biometrics. Iris's high uniqueness and stability are the basis of its identification.

Characteristics:

Biological activity: Iris under the protection of the sclera, biological activity is strong.
Non-contact: No need for users to touch the equipment, no infringement on the person.
Uniqueness: The iris is less likely than other tissues to be identical in shape.
Stability: Permanent after the iris is fixed, common disease will not cause damage to the iris tissue.
Anti-counterfeiting: It is impossible to change iris features with surgery without serious impact on vision.

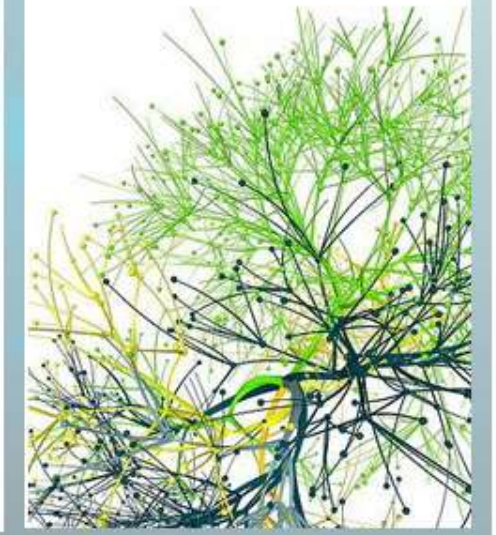


Fingerprint identification technology

From the practical point of view, fingerprint identification is superior to other biometrics. The fingerprint identification system has reached the stage of convenient operation, accurate and reliable, moderate price, and is gradually applied in the civil market.

The process of fingerprint identification:

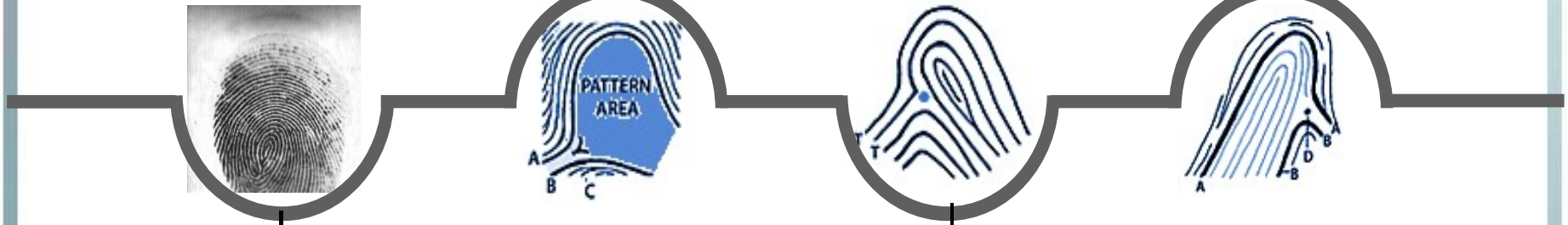
Through special photoelectric conversion equipment and computer image processing technology, the living fingerprint collection, analysis and comparison, can quickly and accurately identify individual identity. The system mainly includes fingerprint image acquisition, fingerprint image processing, feature extraction, feature value comparison and matching.



What are the fingerprint features (overall features)?

Model area: The area of the fingerprint that contains the general features, that is, the pattern area where you can tell which type a fingerprint belongs to.

Number of lines: The number of fingerprint lines in the pattern area.



Pattern: There are three basic patterns: ring, arch and spiral

Triangulation: A point at which the first fork or break from the core, or at which two lines converge, or at which isolated points, turning points, or point to these singularities.

What are the fingerprint features (local features) ?

Ending: A line ends here.

Bifurcation: A line splits here into two or more lines.

Ridge Divergence: Two parallel lines separate here.

Dot or Island: A line so short that it becomes a point.

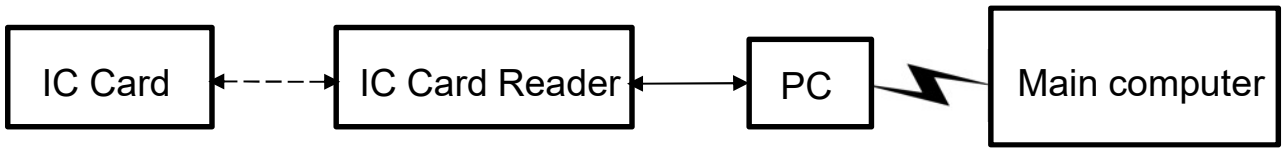
Enclosure: After a line separates into two, it immediately merges into one, forming a small ring called a ring point.

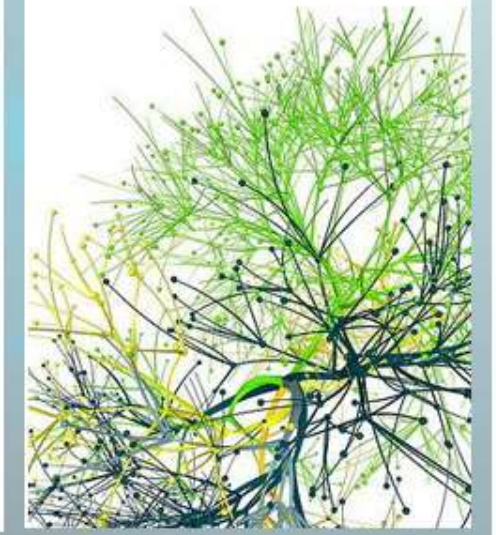
Short Ridge: One end is shorter but not so much a line as a point.

IC card technology

Integrated Circuit Card, has been seen everywhere in daily life. It is, in effect, a data storage system, with additional computing power if necessary.

A standard IC card application system usually includes: IC card, IC card interface device (IC card reader), PC, larger system also includes communication network and main computer, as shown in the figure.





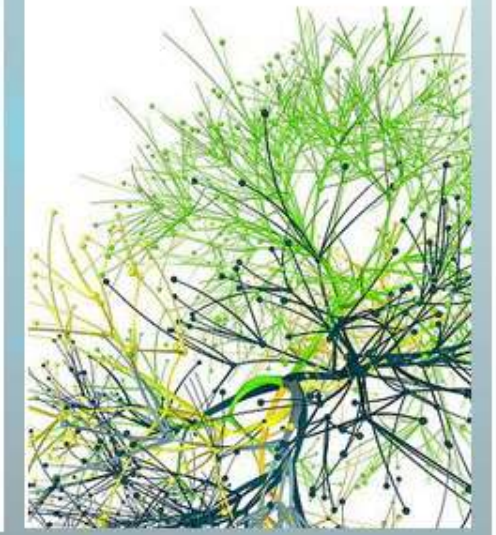
IC card: basic components

IC card: A portable information carrier which is controlled by the cardholder and records the characteristic codes and documents of the cardholder.

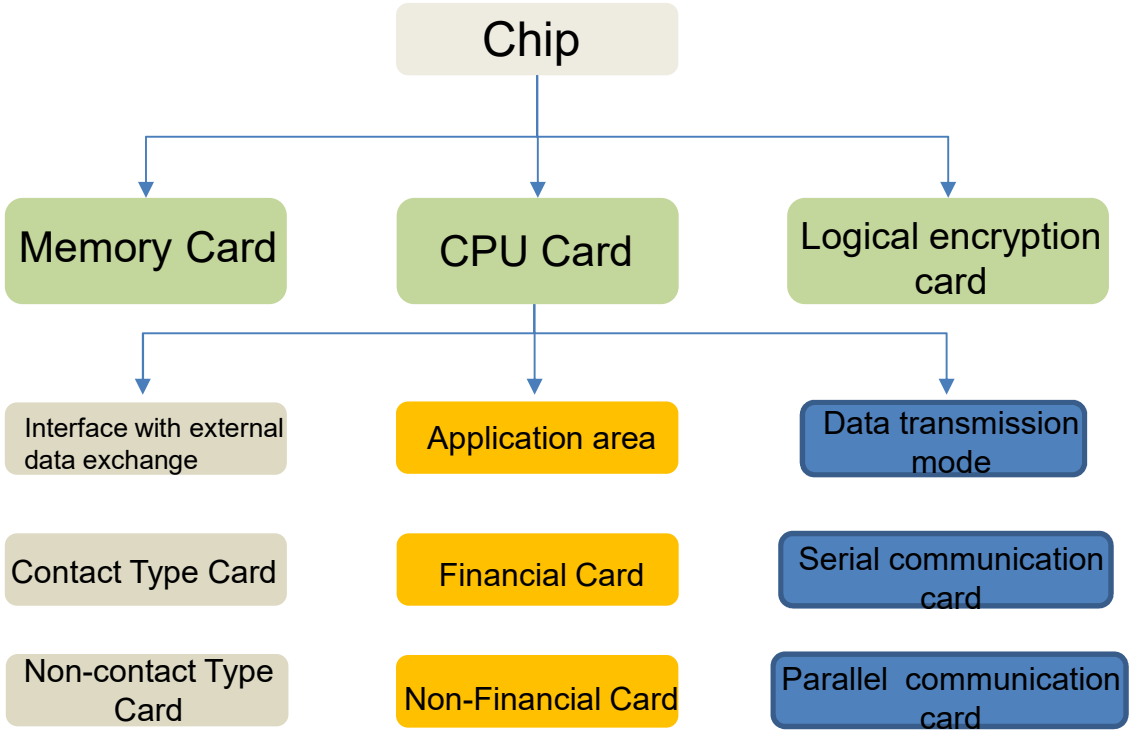
Interface device: IC card reader, is the bridge between card and PC information exchange, and is often the energy source of IC card. The core is reliable industrial control microcontroller, such as Intel 51 series.

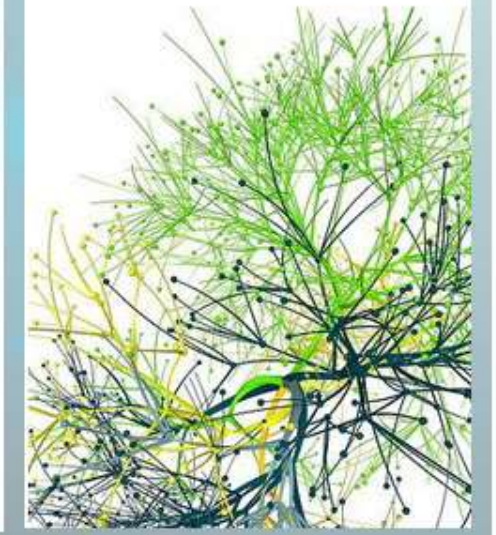
PC: The core of the system, complete information processing, report generation output and instruction issuance, system monitoring and management, card issuance and loss reporting, blacklist establishment, etc.

Networks and computers: Usually used in larger systems such as financial services.



IC card: classification





IC card: Classified by chip

(1) Memory card. Memory chips embedded in Memory Cards are Memory chips. Most of these chips are universal E2PROM (or Flash Memory).Without security logic, the information in the chip can be accessed arbitrarily without restriction. Safety precautions are rarely taken in card manufacturing; It does not fully comply with or support ISO/IEC 7816, but mostly adopts two-wire serial communication protocol (I2C bus protocol) or three-wire serial communication protocol.

Features: Memory card functions are simple, there is no (or very little) security logic, but it is cheap, easy to develop and use, storage capacity growth is rapid, so it is often used for some internal information does not need to be confidential or do not allow encryption (such as emergency card) occasions.

IC card: Classified by chip

(2) Logical encryption card. Logic encryption card is composed of non-volatile memory and hardware encryption logic. It is generally a chip specially designed for IC card. It has security control logic and good security performance. At the same time, ROM, PROM, E2PROM and other storage technologies are adopted. Good security measures are taken from chip manufacturing to delivery, such as taking TC Transport Card; Support ISO/IEC 7816 international standards.

Features: Logical encryption card has a certain security guarantee, more for a certain security requirements, such as insurance card, gas card, driving card, library card, IC card phone and small electronic wallet.

IC card: Classified by chip

(3) CPU card. CPU Cards are also called smart Cards. The hardware composition of CPU card includes CPU, memory (including RAM, ROM, E2PROM, etc.), I/O interface of communication between card and read-write terminal, and CAU of encryption computation coprocessor. In ROM, COS (Chip Operation System) is stored.

Features：

① High computing power, large storage capacity, flexible application and strong adaptability.
② Strong security capability. It can not only verify the legitimacy of the card and the cardholder, but also identify the read-write terminal, which has become the best choice for multi-purpose card and sensitive data security, such as mobile phone SIM card.
③ A true "smart card".

CPU Card: Classified by switching interface

Contact Type

Non-Contact Type

Multiple metal contacts of contact IC card are the information transmission medium between the card chip and the outside world, with low cost and relatively simple implementation. Contactless IC Cards do not use contacts, but with the help of wireless transmission and transmission of information, so the former is not competent in many occasions such as transportation applications.


CPU Card: Classified by application area

According to the different application fields, smart Cards can be divided into financial Cards and non-financial Cards (that is, bank Cards and non-bank Cards).Financial Cards are divided into credit Cards and cash Cards. The former is used at consumption when paying, can press set up in advance to spend overdraw fund, latter can make electron purse and electron bankbook, but do not get overdraw. The non-financial card covers a wide range, including virtually all fields outside the financial card, such as access control card, organization code card, medical card, insurance card, IC card id card, electronic label, etc.

CPU Cards: Classified by data transfer form

Smart Cards can be divided into Serial Communication Cards and Parallel Communication Cards. Serial communication card is the most commonly used card at present, and it is also the interface mode stipulated in the international standard.

Serial Communication Cards is used to exchange information with the outside world. However, with the increase of the memory capacity of chip, two problems are caused. Second, the reading and writing time is too long. The reading and writing capacity of 1 MB takes 12 minutes.

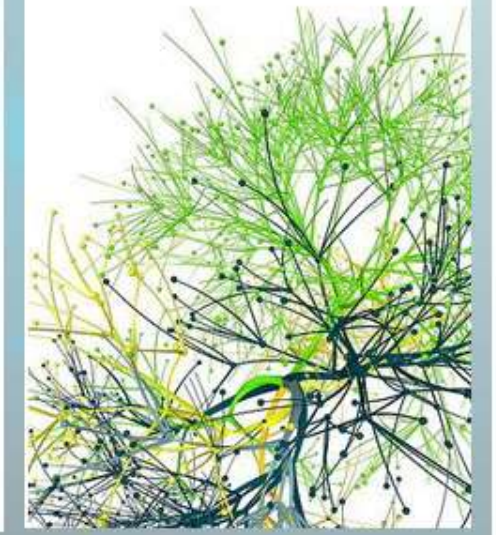
Parallel communication Cards adopt parallel communication, so there are no such two disadvantages, but there is no such interface standard in international standard. For example, the pin number of some p-type IC card is up to 32, which is not only extremely fast, but also increases the capacity. Like serial communication card, it also has storage type, logical encryption type and CPU type, and has been used in tax filing system.

Bar code technology

Bar code technology is in the process of computer application development, in order to eliminate the "bottleneck" problem of data entry and produced, can be said to be the most "ancient" automatic identification technology.

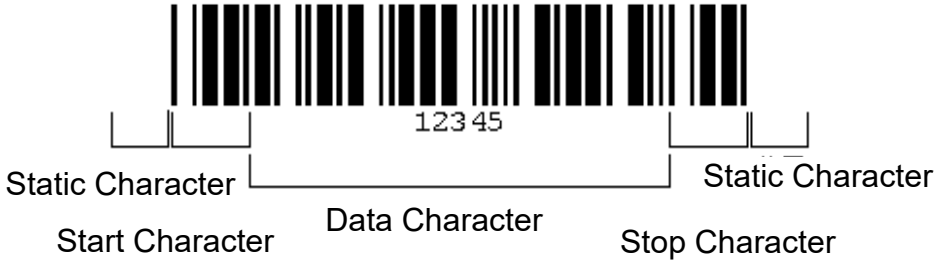
A bar code is a regular set of bars, blanks, and corresponding characters. When these codes are scanned with specialized barcode recognition devices such as handheld barcode scanners, the information contained in the codes is converted into computer-readable data.

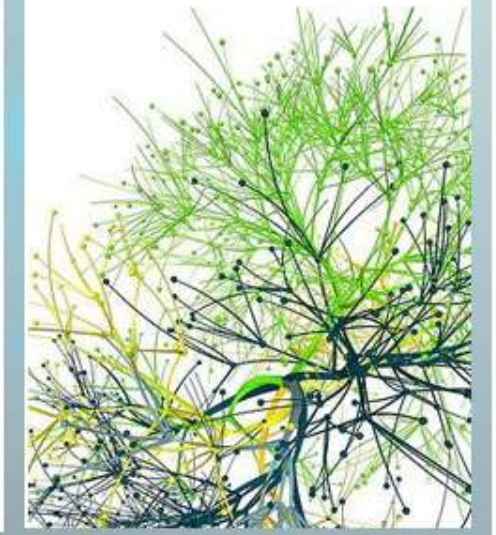
At present, one-dimensional bar code is common in the market, with information of about dozens of bits of data and characters; Two-dimensional barcodes are relatively complex, but can contain thousands of characters.



Barcode technology: One-dimensional barcode

A one-dimensional bar code is a symbol composed of a set of regularly arranged bars, blanks and corresponding characters. Ordinary one-dimensional barcode is only used as identification information in the process of use, its meaning is achieved by extracting the corresponding information in the database of the computer system.
A complete barcode composition sequence is: static area (before), start character, data character, (intermediate separator, mainly used for EAN code), (check character), stop character, static area (after).





One-dimensional barcode: A few basic concepts

Module: The basic unit of bar code is module, which refers to the narrowest bar code or empty bar code. The width of the module is usually measured in mm or mil (one thousandth of an inch).A bar or space that constitutes a bar code is called a unit. The number of modules contained in a unit is determined by the encoding method. In some code systems, such as EAN code, all units are composed of one or more modules. In other codes, such as 39 codes, all cells have only two widths, i.e. wide cell and narrow cell, in which the narrow cell is a module.

Density: The number of characters indicated by a barcode of unit length. The smaller the module size, the higher the density, so the density value is usually expressed as the value of the module size (such as 5mil).Generally, the bar code below 7.5mil is called high-density bar code, and the bar code above 15mil is called low-density bar code.

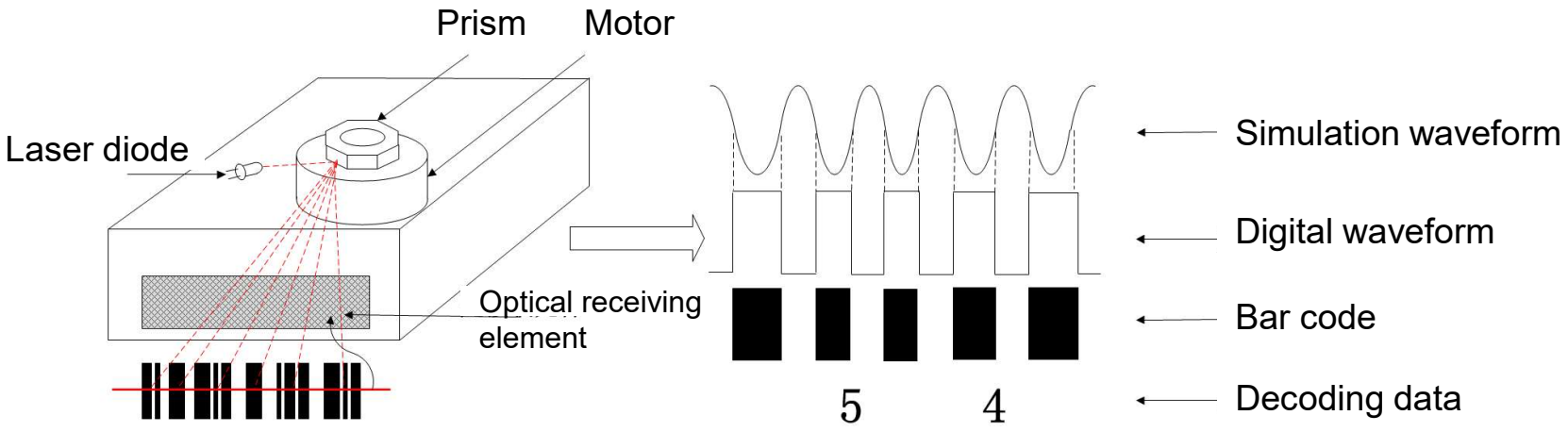
Width-to-width ratio: For codes with only two width-to-width units, the ratio of width-to-narrow units is called width-to-width ratio, which is usually about 2-3 (2:1 and 3:1 are commonly used).When the width is large, it is easier for the reading device to distinguish between the wide cell and the narrow cell, so it is easier to read.

One-dimensional barcode: A few basic concepts(Next)

Contrast (PCS) : Optical index of barcode symbol. The higher the PSC value, the better the optical properties of barcode. PCS= (RL - RD) /RL×100%
(RL: strip reflectivity RD: empty reflectivity)
Bar code length: Length from the leading edge of the bar code start character to the trailing edge of the stop character
Bar code density: The number of characters represented by the bar code of unit length
Bidirectional barcode: Both segments of the barcode can be used as the starting point of the scan.
Intermediate separator: In a barcode symbol, between two adjacent barcode symbols and does not represent an empty space for any information.
Continuous barcode: In a barcode character, a barcode without an intermediate separator between two adjacent barcode characters.
Discontinuous barcode: A barcode in which an intermediate separator exists between two adjacent barcode characters.

One-dimensional barcode: Decoding principle

Laser scanner by sending a beam of light, a laser diode to a rotating prism or back and forth on the mirror, the reflection of light through the exposure to the surface of the bar code reading window, the light through the reflex of the bar or empty return to reader, collected by a mirror, focus, through the photoelectric converter is converted into electrical signals, the signal will be through the scanning period or terminal decoding software decoding.

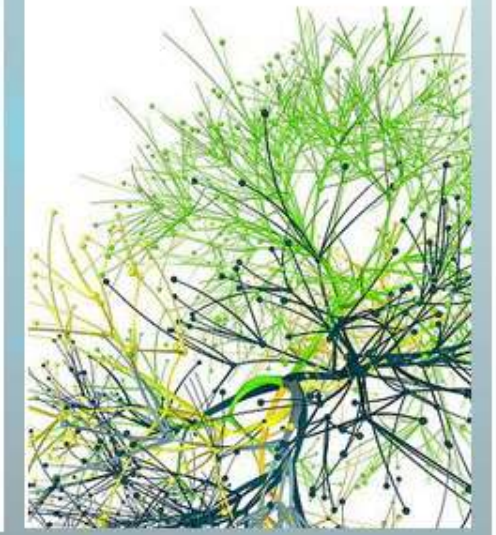



1-d barcode: comparison of typical 1-d barcode system

Code	UPC	EAN	CROSS25	39	Codabar	128	93	49
Length	Fixed	Fixed	Variable	Variable	Variable	Variable	Variable	Variable
Continuity Type	continuous	c	discrete	d	c	c	c	c
Supported symbol	Numerical	Numerical	Self-checking digital	alphanumeric	alphanumeric	Self-checking digital	alphanumeric	alphanumeric
character set	0~9	0~9	0~9,A~Z, - / + % $ space	0~9,- / + % -- $	0~9,- / + % $	ASC II	0~9, A~Z,- / + % $ space	0~9, A~Z,- / + % $ space,F1, F2,F3
Element width	4 types	4 types	2 types	Multiple variable	Multiple variable	4 types	Multiple variable	Multiple variable

Barcode technology: 2d barcode

The two-dimensional code records the symbolic information of data by using the black and white graphics distributed in the plane (two-dimensional direction) according to a certain rule with a certain geometric figure; Using the concept of "0" and "1" bit stream which constitute the logic foundation of the computer skillfully, this paper users several geometric shapes corresponding to binary system to express the numerical information of words, and realizes the automatic processing of information through the automatic reading of image input equipment or photoelectric scanning equipment.
Two-dimension codes have some common characteristics of bar code technology: each code system has its own specific character set; Each character occupies a certain width; Has certain check function and so on. At the same time, it also has the function of automatic recognition of different lines of information, and handles the image rotation.



Barcode technology: 2d barcode

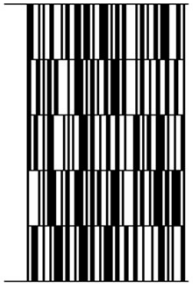
At present, the most widely used 2d barcode symbols in the world include Aztec Code, PDF147, DataMatrix, QR Code, Code16K and so on.

Aztec Code

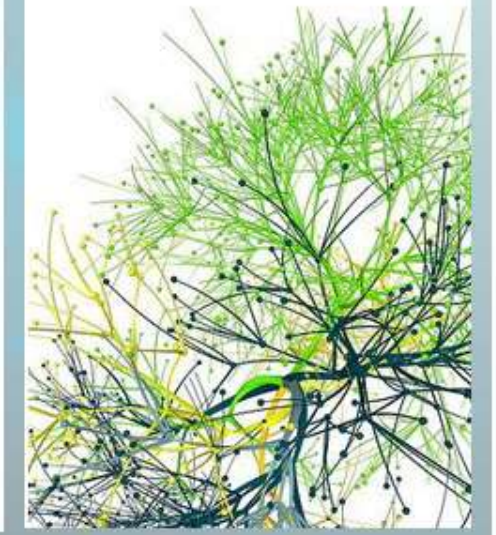
PDF147

QR Code

DataMatrix



Code 16K




Comparison of one-dimensional bar code with two-dimensional bar code

One-dimensional barcode features:

- Can be directly displayed in English, Numbers, simple symbols;
- Not much data is stored, mainly relying on the associated database in the computer:
- Low confidentiality;
- Poor readability after spoilage.

Two-dimensional barcode features:

- Can directly display English, Chinese, Numbers, symbols, graphics;
- Large amount of data storage, can store 1K characters, can be directly read by the scanner, no need to connect to the database;
- High confidentiality (can be encrypted),
- At the highest security level, 50% damage and pollution can still read complete information.

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2.1 Automatic identification technique

2.2 The history and current situation of RFID

2.3 RFID technical analysis

2.4 RFID tag conflict *

2.5 RFID and the Internet of things

RFID is a revolution in computer automatic Identification technology, which greatly improves the efficiency and accuracy of information processing.

2.2 The history and current situation of RFID

RFID is the abbreviation of Radio Frequency Identification, which USES Radio Frequency signals to transmit non-contact information through spatial coupling (alternating magnetic field or electromagnetic field) and achieve the purpose of Identification through the transmitted information. It is an automatic identification technology that emerged in the 1990s and was first used in the European market and then worldwide.

The obvious advantage of RFID over other technologies is that electronic tags and readers can be identified without contact. RFID technology has changed the way barcodes rely on "tangible" one-dimensional or two-dimensional geometric patterns to provide information, using chips to provide a huge amount of "intangible" information stored in them.

2.2 The history and current situation of RFID

Time	Event
1941-1950	Radar technology gave birth to RFID, which laid the theoretical foundation in 1948.
1951-1970	The early exploration stage of RFID technology is still in laboratory experimental research.
1971-1980	With RFID technology theory further development, people began to try some new applications.
1981-1990	RFID technology and products into the commodity application stage, all kinds of scale applications began to appear.
1991-2000	RFID technology standardization is getting more and more attention, RFID application is becoming rich, has become a part of people's life.
2000-Now	RFID products are more diverse, all kinds of tags have been greatly developed, the cost of tags has been continuously reduced, the scale of the application industry began to expand.


2.2 The history and current situation of RFID

At present, the application of RFID technology has been in the stage of comprehensive promotion. Especially for IT industry, RFID technology is regarded as the next "gold mine" of IT industry. Major hardware and software manufacturers including IBM, Motorola, Philips, TI, Microsoft, Oracle, Sun, BEA, SAP and other enterprises have shown a strong interest in RFID technology and its application, and have invested a large amount of research and development funds to launch their own software or hardware products and system application solutions.

In the application field, many enterprises represented by Wal-Mart, UPS and Gillette have begun to comprehensively use RFID technology to transform their business systems, so as to improve their work efficiency, management level and provide various value-added services for customers.

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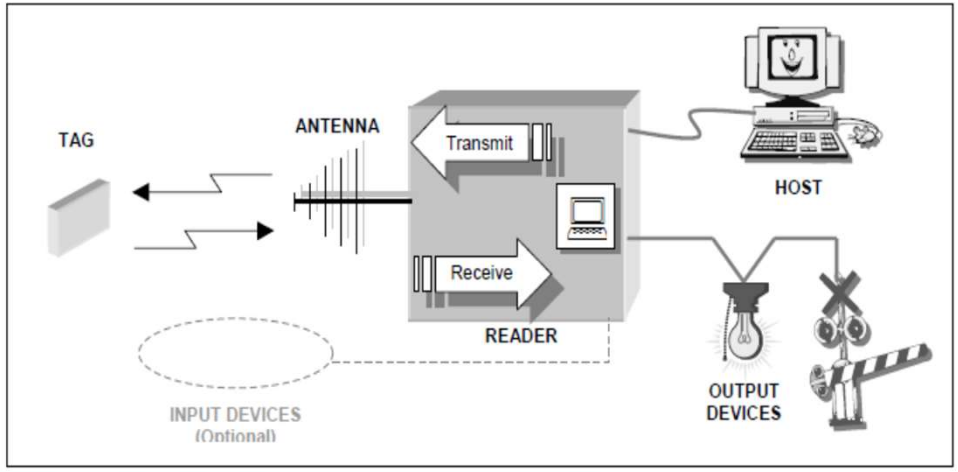
What are the basic components of RFID?
What are the important parameters?

2.3 RFID technical analysis

RFID system consists of five components, including: transmitter, receiver, microprocessor, antenna, tag. Transmitters, receivers and microprocessors are often packaged together, also known as readers, so the industry often divides RFID systems into Reader, antenna and tag components, all of which can be manufactured by different manufacturers.



2.3 RFID technology analysis: reader

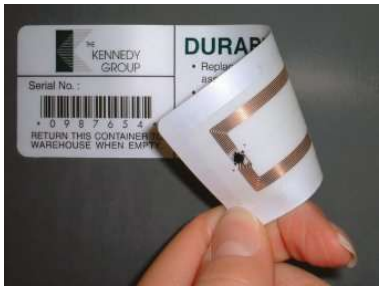
Reader is the most important and complex component of RFID system. Because of its working mode is generally take the initiative to ask tag identification information, so sometimes also known as Interrogator (Interrogator).The following figure shows different types of readers. The reader can connect to the host through standard network port, RS232 serial port or USB port, and communicate with RFID tag through antenna. Sometimes, for convenience, readers and antennas and smart terminal devices will be integrated together to form portable handheld readers.

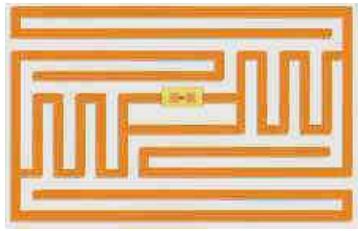
2.3 RFID technical analysis: antenna

The antenna is connected to the reader and is used to transmit radio frequency signals between the tag and the reader. The reader can connect to one or more antennas, but only one antenna can be activated each time it is used. The working frequency of RFID system varies from low frequency to microwave, which makes the matching between antenna and tag chip very complicated

2.3 RFID technical analysis: Tags

Tags are composed of coupling elements, chips and tiny antennas. Each Tag contains a unique electronic code, which is attached to the object and used to identify the target object. After the tag enters the RFID reader scanning field, it receives the radiofrequency signal from the reader, and sends the electronic code (passive tag) stored in the chip or the signal of a certain frequency (active tag) by virtue of the energy obtained by the inductive current.





Label: Storage mode

Electrically erasable programmable read-only memory (EEPROM) : The common radio frequency identification system mainly adopts EEPROM. The disadvantage of this approach is that the writing process consumes a lot of power consumption, and the service life is generally 100,000 times

Ferroelectric random access memory (FRAM) : Compared with EEPROM, FRAM writing power consumption reduces by 100 times and writing time even shortens by 1000 times. FRAM belongs to non-volatile memory. However, FRAM has not been widely used due to production problems.

Static random access memory (SRAM) : SRAM can write data quickly and is suitable for microwave system, but SRAM needs continuous power supply from auxiliary battery to save data.


Tag

Passive Tag: As there is no power device inside, Passive Tag is also called Passive Tag. The integrated circuit inside the passive tag sends data to the reader, driven by electromagnetic waves emitted by the reader.

Active Tag: The internal power supply of the Tag is also called Active Tag. Power supply devices and their associated circuits determine that active tags are larger and more expensive than passive tags. But the active tag communication distance is longer, can reach hundreds of meters away.

Semi-active Tag: This Tag combines all the advantages of passive Tag and active Tag. It carries a battery inside and can provide power for internal calculation of the Tag. The tags can carry sensors that can be used to detect environmental parameters such as temperature, humidity and movement. Unlike active tags, however, they do not require batteries to provide energy for their communication. Like passive tags, they obtain energy from electromagnetic waves emitted by readers.


What are the advantages of RFID tags over bar codes?

Small size and diverse shapes: RFID tags are not limited by size and shape in reading, and do not need to match the fixed size and printing quality of paper for reading accuracy.

Environmental resistance: Paper easily contaminated and affect identification. However, RFID has strong pollution resistance to water, oil and other substances. In addition, RFID tags can be read even in the dark.

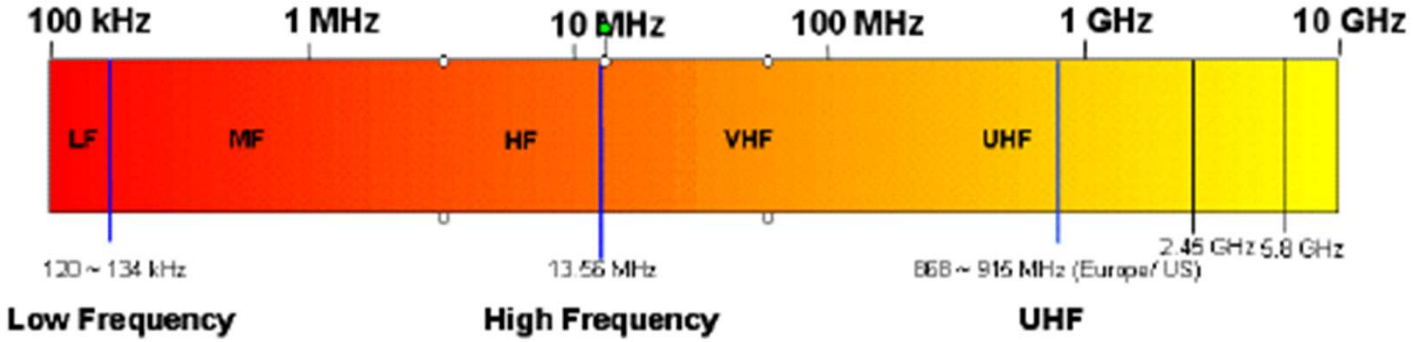
Reusable: Tags can be read and written, and electronic data can be repeatedly overwritten, so they can be recycled and reused.

Strong penetrability: The label can also communicate with other non-metallic or non-transparent materials, such as paper, wood and plastic.

Data security: The data in the label is verified by cyclic redundancy to ensure the accuracy of the data sent by the label.

2.3 RFID technology analysis: Frequency

RFID frequency is a very important parameter index of RFID system, which determines the working principle, communication distance, equipment cost, antenna shape and application field. The typical working frequencies of RFID are 125KHz, 133KHz, 13.56mhz, 27.12mhz, 433MHz, 860-960mhz, 2.45ghz and 5.8ghz.According to different working frequencies, RFID systems are concentrated in three areas: low frequency, high frequency and uhf.




RFID Frequency

The low frequency (LF) range is 30khz-300khz. The typical low frequency working frequency of RFID is 125kHz and 133kHz, and the wavelength of this frequency band is about 2500m.Low-frequency tags are generally passive tags, and their working energy is obtained from the radiation field of the coupling coil of the reader through inductively coupling, and the communication range is generally less than 1 meter. In addition to the influence of metal materials, the low-frequency signal can generally pass through the object of any material without reducing its reading distance.

The range of high frequency (HF) is 3 mhz-30 MHz, and the typical working frequency of RFID is 13.56MHz. The wavelength of this frequency is about 22 meters, and the communication distance is generally less than 1 meter. The tag of this frequency no longer needs coil winding, and the antenna inside the tag can be made by corroding or printing, and the energy can be obtained from the reader's radiation field by inductively coupling.

RFID Frequency

UHF range is 300mhz-3ghz, and above 3GHz is microwave range. RFID systems using uhf and microwave are generally referred to as uhf RFID systems. The typical working frequencies are: 433MHz, 860-960mhz, 2.45ghz, 5.8ghz, and the frequency wavelength is about 30cm.Technically, the 2.45ghz and 5.8ghz are in the microwave range. Uhf tags can be active tags and passive tags, which communicate with readers through electromagnetic coupling. The communication distance is generally more than 1 meter, typically 4-6 meters, and the maximum can be more than 10 meters.

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When multiple tags are within the recognition range of the reader or multiple tags send mark signals to the reader at the same time, tag signal conflicts will occur.

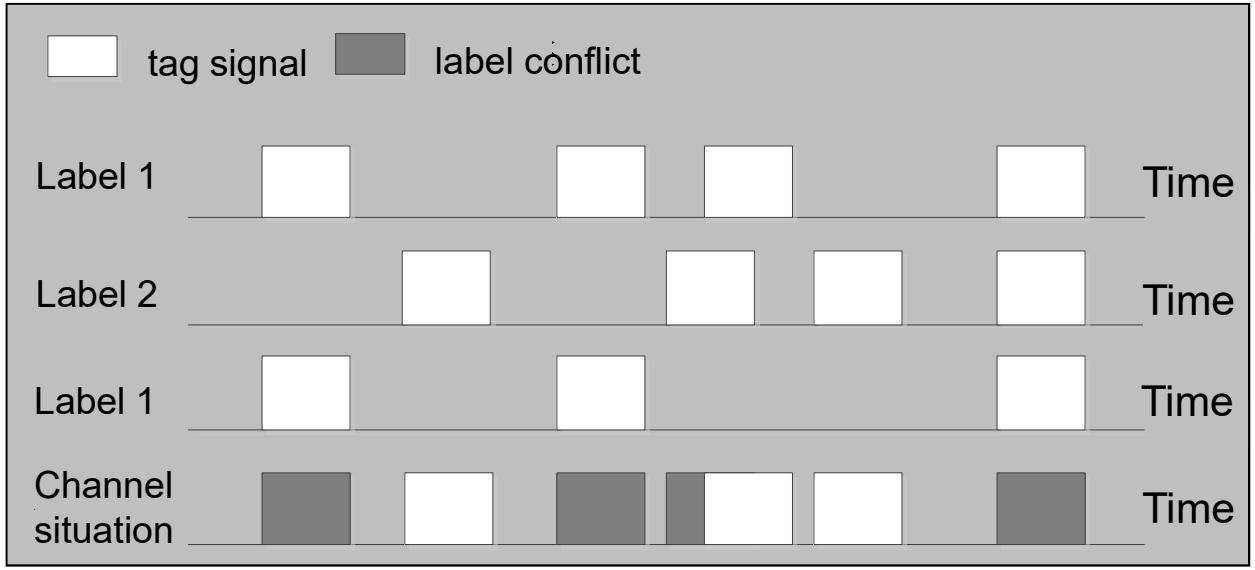
2.4 RFID tag conflict

Tag signal conflict: As the communication distance of the reader increases, the area of its recognition area gradually increases, which often causes multiple tags to be within the recognition range of the reader at the same time. However, since the reader shares a wireless channel with all tags, when more than two tags send an identification signal to the reader at the same time, the signal will be superimposed and the reader cannot properly parse the signal sent by the tag. This problem is often referred to as tag signal collision problem (or collision problem), and the solution to the conflict problem is called anti-collision algorithm (or anti-collision algorithm, anti-collision algorithm).

Anti-collision algorithm based on ALOHA

Pure ALOHA anti-collision algorithm

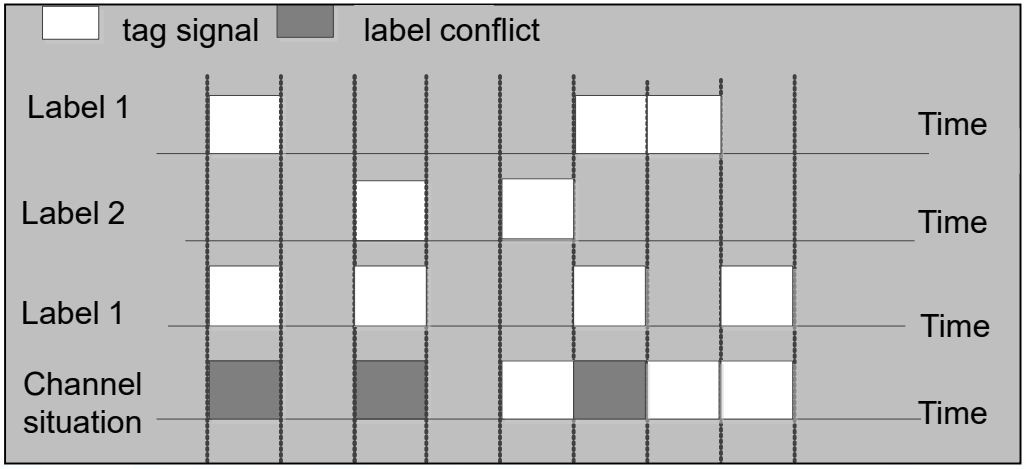
The algorithm is simple and easy to implement, but the channel utilization rate is only 18.4%, the performance is not ideal.



Anti-collision algorithm based on ALOHA

Time-slot ALOHA anti-collision algorithm (s-aloha)

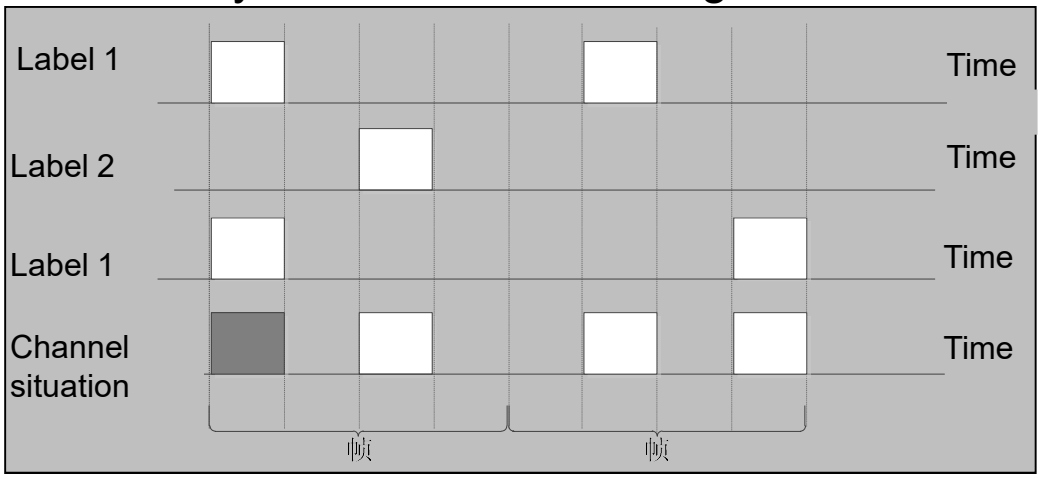
S-aloha algorithm divides the time of pure ALOHA algorithm into several time slots, each time slot is greater than or equal to the length of time sent by label identifier, and each label can only send identifier at the beginning of time slot. Due to the time synchronization of the system, the channel utilization of s-aloha protocol reaches 36.8%, which is twice that of pure ALOHA.



Anti-collision algorithm based on ALOHA

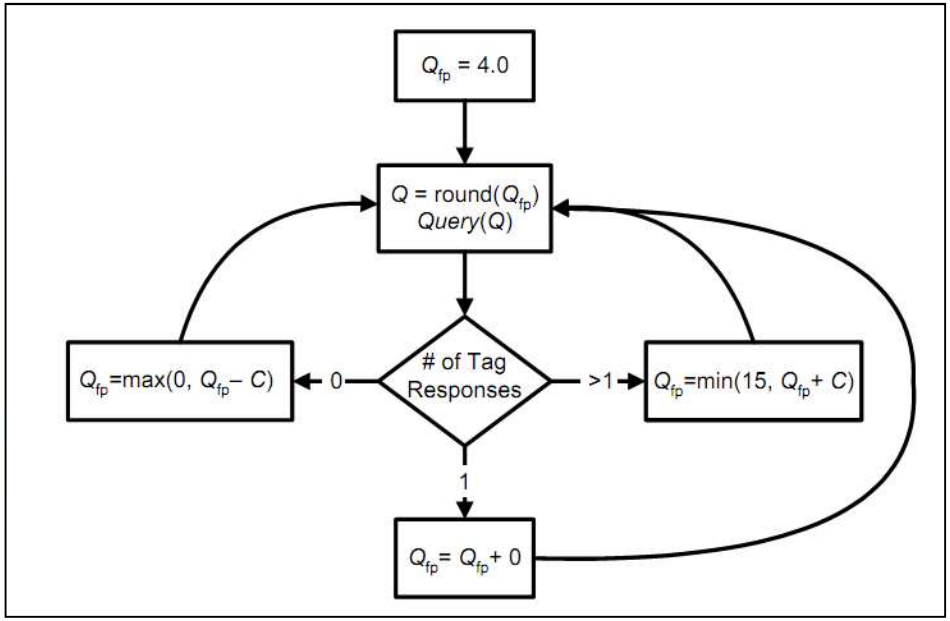
Frame-based time-slot ALOHA anti-collision algorithm (FSA)

On the basis of s-aloha, several time slots are organized into one frame, and the reader recognizes the frame as a unit. The advantages lie in simple logic, simple circuit design, less memory required, and only sending once randomly within the frame can further reduce the probability of conflicts. FSA has become one of the most commonly used anti-collision algorithms based on ALOHA in RFID systems.



Anti-collision algorithm based on ALOHA

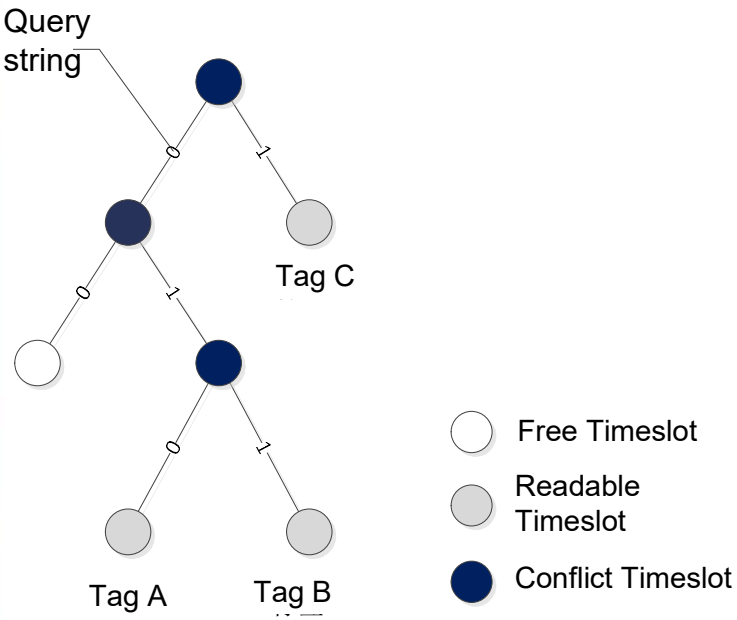
Q Algorithm



The dynamic adaptive frame length algorithm can solve the limitation of fixed frame in FAS algorithm. At present, there are two popular methods: one is to estimate the current number of labels and set the optimal length of the next frame according to the number of empty time slots obtained by previous frame communication, the number of time slots for collisions and the number of time slots for successfully identifying labels; Another method dynamically adjusts the integer multiple of frame length 2 according to the feedback of the previous time slot. This method is most representative of Q algorithm designed in EPCglobal Gen2 standard.

Conflict prevention algorithm based Binary tree

Random binary tree



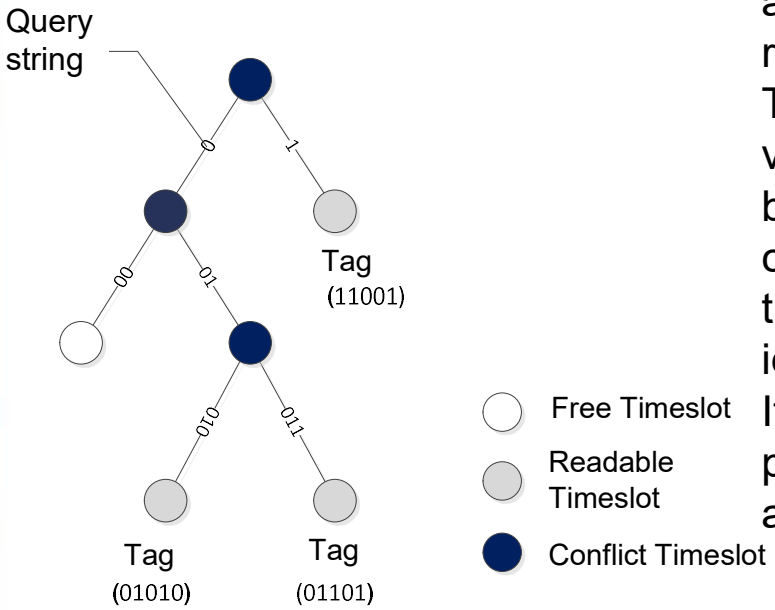
The random binary tree algorithm requires each label to maintain a counter with an initial value of 0.At the beginning of each slot, if the counter of the label is zero, it immediately sends its own identifier, otherwise the slot does not reply. All tags that have been successfully recognized are in a silent state and do not reply to the reader commands of later time slots.

If there is a conflict in that slot, the label that sends the symbol will randomly select one of the 0 or 1 Numbers and add it to its counter.

The whole recognition process is like traversing the order in the binary tree.

Conflict prevention algorithm based Binary tree

Query binary tree



The query binary tree algorithm is a stateless protocol, which does not need to maintain any state inside the tag. The tag only needs to be compared according to the identifier prefix broadcast by the reader.

The reader maintains a binary prefix with an initial value of 0.At the beginning of each slot, the reader broadcasts the binary prefix, and the electronic tag compares the first few bits of its own identifier with this binary prefix, and immediately sends the identifier if it is the same.

If the reader detects a conflict, add a 0 or 1 to the previous binary prefix in the next query, re-query, and repeat until all tags have been identified.

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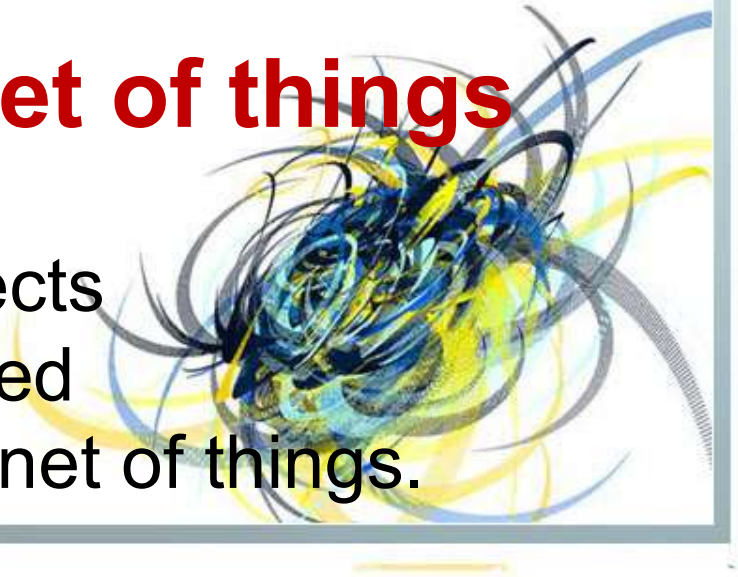


The unique identification of objects based on RFID tags has triggered a boom of research on the Internet of things.


2.5 RFID and the Internet of things

Based on the unique identification characteristics of RFID tags on objects, it has triggered a boom of research on the Internet of things.
The Internet of things is to build up the information network of all goods involved in circulation on the basis of the existing Internet by attaching RFID tags to all goods.
The establishment of the Internet of things will have a profound impact on all aspects of the circulation of goods such as manufacturing, sales, transportation, use and recycling, as well as the behavior of governments, enterprises and individuals.
Through the Internet of things, everything in the world can be identified, tracked and monitored anytime, anywhere, on demand. The Internet of things is seen as the next revolution in the IT industry after the Internet.

Conclusion

Review

- This chapter introduces the common automatic identification methods and technologies, including: optical symbol identification technology, speech recognition technology, biometric identification technology, IC card technology, bar code technology and RFID radio frequency technology
- This chapter focuses on RFID technology, including the history and current situation of RFID, RFID technology analysis and RFID tag conflict.


Conclusion

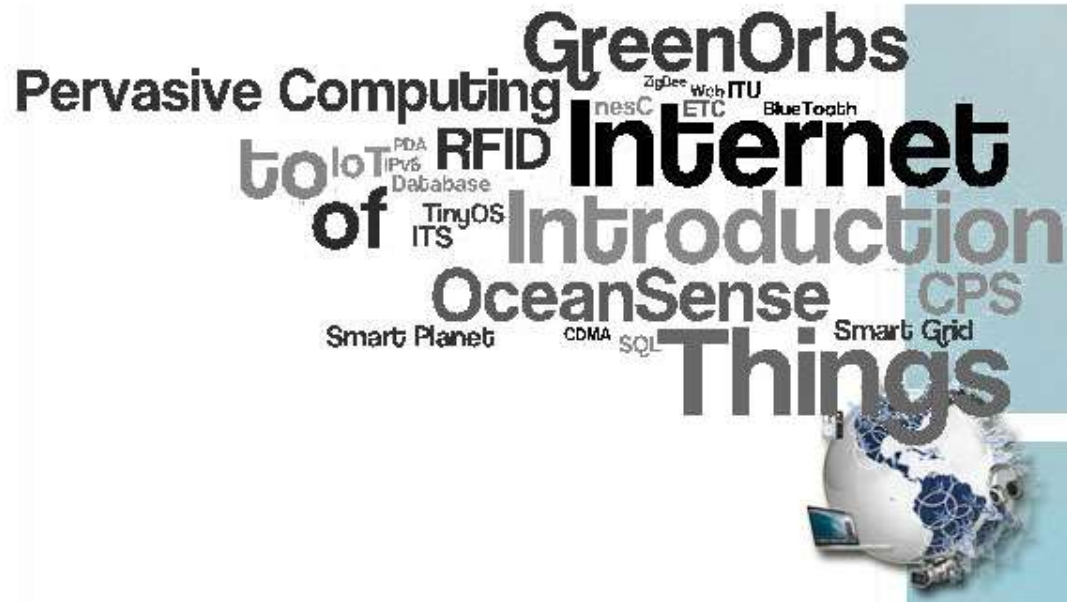
Key Points

- The basic concept of optical symbol recognition technology, the process of speech recognition, the characteristics of iris recognition, the overall features and local features of fingerprints.
- Composition and classification of IC card system.
- The classification of bar code, the composition of one-dimensional bar code, the concept of bar code module; The basic parameters and working principle of one-dimensional bar code, the comparison of two-dimensional bar code and one-dimensional bar code, the common one-dimensional bar code and two-dimensional bar code.

Conclusion

Key Points

- The concept and status of RFID.
- Composition of RFID system, advantages and characteristics of RFID tags, storage mode and classification of RFID tags, common frequency of RFID system and its advantages and disadvantages.
- The concept of RFID tag collision and anti-collision algorithm, the classification of anti-collision algorithm, and the detailed description of the Frame-based time-slot ALOHA protocol, Q protocol, random binary tree protocol and query binary tree protocol. The pros and cons of each of these agreements.



Thank you!

Internet of Things