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Key Internet of Things Technology and Application Research

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Abstract

Key core technologies of IOT (internet of things) have to be addressed to achieve rapid development. This paper focused on studying RFID, wireless sensor network (WSN) and TCCP which were integrated to address the IOT application problems. Meanwhile, an IOT architectural model was established and the IOT applications in real-time medical monitoring, intelligent transportation system (ITS), intelligent appliances and intelligent agriculture were introduced.

Keywords: *IOT, RFID, WSN, TCCP, application*

1. Introduction

IOT is the third wave of global information industry after computer and internet, which guides the future development direction of information technology. China's "12th Five-Year Plan" clearly labels the IOT as one of the key new information technologies. IOT plays an important role in the change of economic development mode and promotion of social transformation as well as industrial upgrading [1].

2. Concept of IOT

Internet of things (IOT) connects all goods with internet through information sensing devices like radio frequency identification (RFID) for information exchange and intelligent identification, positioning, tracking, monitoring and management of goods [2]. IOT is not only a network, but also a system. It connects all living articles with the internet to form a larger network where we can gain, process, extract and use information about articles reasonably. IOT makes our production and life unprecedented convenient.

3. Key Technologies of IOT

IOT was proposed and developed under abundant technical supports, such as sensor network, RFID, pervasive computing, cloud computing, real-time system, etc. The key technologies of IOT include RFID, WSN and TCCP.

3.1. RFID

As a non-contact automatic identification technology, radio frequency identification (RFID) can identify the target object automatically through the radio frequency signals and acquire associated data, thus applicable to various severe environments [3]. With easy and convenient operations, RFID can identify high-speed moving objects and multiple labels simultaneously. Global item tracking and information share can be realized by integrating RFID with internet and communication technologies.

3.2. WSN

Sensing is very important to the construction of IOT. Multiple sensors with communication and computing power are connected in wireless and cooperate with each other to exchange with the physical world and accomplish specific application tasks, forming a sensor network [4]. Sensor network integrates various interdisciplinary technologies, such as sensor technology, embedded computing technology, distributed information processing technology

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and wireless communication technology. A multihop self-organizing system is established in the sensor network through wireless communication, which is responsible for perception collection, processing information perceived within the coverage area of the network, flexible monitoring of these perceived information and information transmission to users. IOT connects all goods with internet through RFID and contributes an intelligent goods identification and management.

Sensor network is mainly responsible for environmental data collection. Associated researches of sensor network mainly involve sensor, communication and computation (including hardware, software and algorithms) [5]. On one hand, the sensor network can be viewed as an integrated network of information collection, processing and utilization, an expansion of information share of internet. Information collection enhances the information processing capacity. On the other hand, the sensor network can be viewed as a new interconnected information processing network developed from sensor nodes. In the sensor network, a lot of sensor nodes are scattered within a certain region, which can be divided into different clusters according to their geographical coordinates. In each cluster, there’s one master node responsible for communication route and other management in the cluster. In addition, there’s one sink node responsible for communication with backbone networks (e.g. internet).

3.3. TCCP
3.3.1. Classification of TCCP

There are three types of TCCP: TCCP for data storage, TCCP for data processing and comprehensive TCCP for data storage and processing.

3.3.2. Prominent Features of TCCP Services

(1) Universal availability: TCCP services are available to users at any time anywhere with a basic compute device and effective internet accessibility.

(2) Computational cost-effective: Users need the TCCP services, but they have no economic or technical conditions to provide such TCCP services independently. For example, some enterprises require large-scale operation regularly, but it is unnecessary for them to equip with a compute device with large-scale operation function. The supercomputing center develops client base and users can use the super computer to accomplish their computing tasks at a shared cost.

(3) User-oriented applications: TCCP provides computing power (including processor, RAM, storage and network interface), but shows no care to users’ applications. Users have developed many diversified applications with the computing power of TCCP in full consideration to its (technical and economic) limitations. TCCP satisfying abovementioned considerations can further be divided into Iaas (e.g. online storage and database service), PaaS (e.g. AMP virtual hosting and Java EE application server) and SaaS (e.g. Google Docs) according to the service level[6]. Distributed computing, paralle computing, grid computing and utility computing are often mentioned by manufacturers when discussing cloud computing. In fact, users only care about the availability and cost of services instead of these new names. These concepts are technical details that TCCP providers have to known during the construction of TCCP. They can be viewed as the representation of cloud computing, but not the nature of cloud computing.

4. IOT Architectural Model

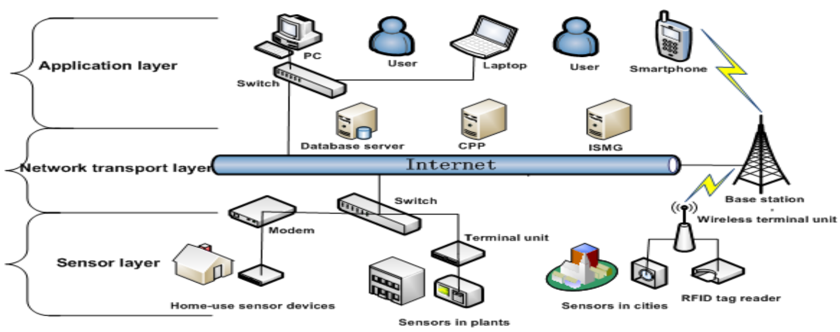

Figure 1. IOT Architectural Model

The IOT architectural model involves three layers: sensor layer for data sensing in the bottom, network transport layer for data transmission in the middle and application layer combined with industrial need at the top [7]. The IOT architectural model was shown in Figure 1.

4.1. Sensor Layer

Sensor layer is mainly for object identification and data collection. It can acquire dynamic and static information (e.g. object properties, environmental state and behavioral state) and identify state in a large-scale and distributed manner through mobile terminal, sensor, RFID, two-dimension code and real-time location technique. With respect to specific sensing task, online computation of diversified, multi-angle and multiscale information is conducted through cooperative accessing. Furthermore, sensor layer is also responsible for interaction and information transmission with shared resources of other units in the network. Sensor layer is for perceiving and acquiring corresponding information, just like the sense organs of human beings.

4.2. Network Transport Layer

Information interconnection is realized in the network transport layer. Perceived information can be transmitted safely through INTERNET, INTRANET, GSM and CDMA. This transport layer mainly involves equipments for accessing to different heterogeneous communication networks, such as Internet Gateway and Mobile Internet Gateway. Complicated software protocols are applicable due to the strong hardware support of these equipments. The network transport layer is responsible for transmitting and processing information acquired by the sensor layer, just like the nerve center and brain of human beings.

4.3. Application Layer

As the interface between IOT and users, application layer combines with industrial need to achieve intelligent IOT application. In the application layer, practical industrial applications-oriented management platform and operation platform are established according to user demand. Associated content services are integrated together according to the characteristics of different applications. More exquisite and accurate intelligent information management requires cooperation with professional knowledge and business model of different industries, such as medical monitoring, intelligent transportation system, intelligent appliance and intelligent agriculture.

5. Applications of IOT

IOT is widely applied in the world, such as real-time medical monitoring, intelligent transportation system, intelligent appliance and intelligent agriculture.

5.1. Real-time Medical Monitoring

Wireless sensor network based on IOT has achieved outstanding effect in monitoring physiological data, elderly health conditions, hospital drug management and telemedicine. Remote diagnosis can be realized by placing a sensor for body temperature, breathe and blood pressure measurement on patients. Physiological data important to new drug development can be collected for a long time through the sensor network. Such wireless sensor network based on IOT, if productized to some extent, can become a security assistant of elderly and disabled patients. Furthermore, it also can be used by disabled rehabilitation centers to monitor recovery progress of patients accurately and provide valuable references for the design of rehabilitation programs.

5.2. Intelligent Transportation System

As the development direction of future transportation system, intelligent transportation system (ITS) is a large-scale real-time, accurate and efficient comprehensive transportation management system established on the basis of an effective integration of advanced information technology, data communication transmission technology, electronic sensor technology, control technology and computer technology. ITS has attracted high attentions from countries in the world for its superiorities, such as effective utilization of existing traffic facilities, reduction of traffic load and environmental pollution and higher transportation safety as well as transport efficiency.

5.3. Intelligent Appliance

Intelligent appliance refers to household appliances with automatic failure monitoring, automatic measurement, automatic control, automatic adjustment and remote communication control functions by integrating with IOT technology.

5.4. Intelligent Agriculture

In intelligent agriculture, equipment can be opened or closely automatically according to the real-time room temperature, soil temperature, CO2 concentration, humidity signal, illumination, leaf humidity and dew-point temperature collected by IOT. Furthermore, IOT not only can automatically process and monitor comprehensive ecological information of agriculture according to user demand, but also can provide scientific evidences for automatic control and intelligent management of environment. Remote humidity and temperature control of greenhouse can be realized through temperature sensor and data transmission of wireless signal receiving and dispatching module [8, 9]. Intelligent agriculture also includes intelligent grain depot system which can balance the temperature and humidity in the grain depot through a real-time monitoring reported to computer or cell phone.

6. Conclusion

With the rapid development of information collection and intelligent computing technology as well as the wide application of internet and mobile radio communications, it is the time for large-scale development of IOT and associated industries. Although IOT is an emerging technology at present, it will surely become a key development industry in future at such quick development speed.

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