STUDY ON APPLICATION OF INTERNET OF THINGS BASED ON RFID TECHNOLOGY

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Key words: The Internet of Things, RFID technology.

Abstract: The advent of era of the Internet of Things has initiated a new information industrial revolution, attracting more and more attention of people. The article has described the system architecture of the Internet of Things and working principle of RFID technology, emphasized the composition and working principle of the Internet of Things based on RFID technology, also analyzed some existent problems in the development of the Internet of Things, and forecasted its application prospect.

1 INTRODUCTION

The concept was first put forward by the Automatic Identification (Auto-ID) Center founded at the Massachusetts Institute of Technology (MIT) in 1999, which is used to solve the interconnected problems from item to item, from human to item, from human to human. The Internet of Things that is considered as the third wave of world information industry following the computer and Internet (Yang and Gao, 2009) has arisen worldwide concerns. Recent great progress has been made in the development of the Internet of Things with the major efforts of all countries based on their own national situations. China is also highly focused on the study on the Internet of Things, and the Ministry of Industry and Information Technology has started the study on new generation information technology jointly with other organizations concerned in order to form the policies and measures which support the development of new generation information technology.

With the development of the Internet of Things, a large number of equipments for the Internet of Things have emerged, of which RFID is widely used in the Internet of Things since it is characterized by its ability of reading tags at a distance, high reading speed, identification of high-speed objects and non-contact method. RFID technology is the core in the systems of the Internet of Things, which is regarded as one of the most important and promising information technology in 21st century due to its uniqueness and reliability (ITU, 2005).

2 OVERVIEW OF THE INTERNET OF THINGS

The concept of “the Internet of Things” was first proposed by Auto-ID in the United States in 1999. In Nov. 2005, in the World Summit on the Information Society (WSIS) held by Tunis, International Telecommunication Union (ITU) released *ITU Internet reports 2005: Internet of Things,* which noted that the ubiquitous "Internet of Things" heralding the dawn of communication era, everything from tires to toothbrushes, from house to paper towels could be communication range via the Internet. In Nov. 2008, IBM put forward the concept“Internet + Internet of Things = Wisdom of the Earth”, President Obama said that the United States would maintain and regain competitive advantage in the 21st Century by technology of the Internet of Things in response to the concept in Jan. 2009. In Aug. 2009, Premier Wen Jiabao proposed “Sensing China” while doing research at sensor network center in Wuxi City of Jiangsu Province, China. The Internet of Things has brought a new opportunity to the development and revolution in the information field and will make great contributions to solve the modern social problems. At present, the commonly accepted definition of the Internet of

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Things is: through the radio frequency identification (RFID), infrared sensors, global positioning systems, laser scanners and other information sensing device, to connect any items with the Internet for information exchange and communication according to the agreed protocol so as to achieve intelligent identification, location, tracking, monitoring of a network. The conceptual model diagram of the Internet of Things is shown in Figure 1.

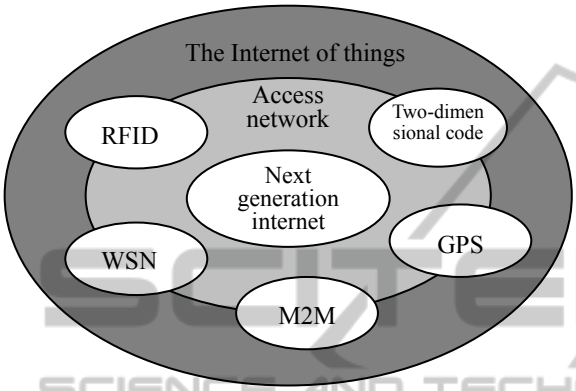

Figure 1: Conceptual Model Diagrams of the Internet of Things.

As can be seen in the above figure, the Internet of Things makes use of sensing technology such as RFID, sensors, two-dimensional code for information acquisition, through integration of wireless network with Internet to transmit the real-time information to the users accurately, and analyze and process vast amounts of data with artificial intelligence technology so as to achieve intelligent control for items.

3 RFID TECHNOLOGY

Radio-frequency identification (RFID) is a non-contact automatic identification technology, using RF signal to automatically recognize target and access to relevant data. RFID can identify the items automatically and multiple tags simultaneously as well as high-speed moving objects, even under poor working conditions. It is an advanced automatic identification technology currently.

As a result of different application, the composition of RFID system is not the same, which generally consists of three basic components: RFID tags, readers and computer communication network. The composing principle is shown in Figure 2.

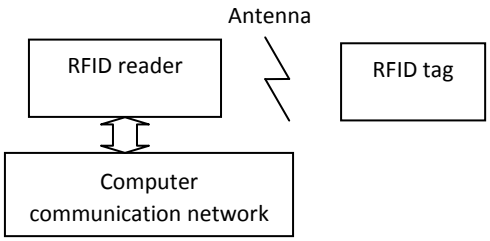

Figure 2: RFID Reader Block Diagram.

Radio Frequency Identification (RFID) also known as electronic tag consisting of coupling element (antenna) and chips, is used as a data storage device of RFID system. Each tag has a unique electronic identification (ID) that is frequently attached to the surface of the objects to be identified to store the relevant information.

RFID reader also known as reader is mainly used to read and erase the tag information, which can receive and send radio signals with external antenna. Reader can achieve the purpose of automatic identification of objects, namely which can read and identify the stored electronic data on the tag without contact. Normally, RFID reader will read and transmit the electronic tag information to the computer connected with it to process the corresponding data.

Computer communication network is mainly used in collection and processing of electronic tag and data after RFID reader read to perform communication transfer function.

Most of RFID system follows the operating principles of inductively coupling, first RF signals of specific frequencies are sent from the RFID reader, the electronic tag will be activated when it enters into the magnetic field, and then transmit the tag information through its antenna to the reader, after the reader receives the information it decodes the information, and then sends to the back-end computer controller to carry out appropriate control and processing according to different setting. All of above activities are fulfilled with RFID communication method.

4 INTERNET OF THINGS BASED ON RFID TECHNOLOGY

RFID-based Internet of Things refers to intelligent identification and management for all real world items through connection of all of items with the Internet via sensor equipment of RFID and so on. RFID-based Internet of Things system consists of

following five components: tag layer, RF communication layer, reader layer, Internet layer, application system layer (the relationship with each other is shown in Figure 3).

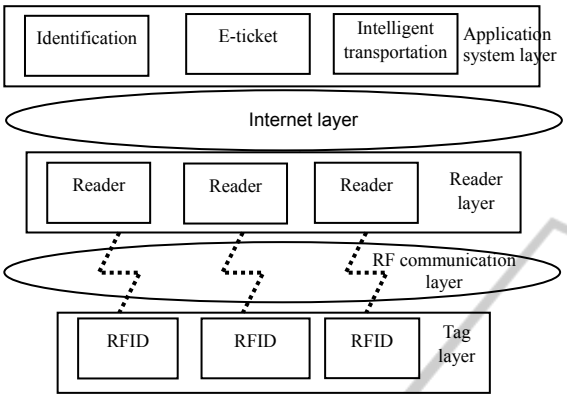

Figure 3: System of RFID-based Internet of Things.

Tag layer: it consists of two parts, items and Radio Frequency Identification (RFID) tags attached to the items. Each electronic tag has stored the information to identify the item. RFID tags can be divided into two categories according to power supply: active and passive RFID tags.

RF communication layer: RFID is a non-contact automatic identification technology, using RF signal to automatically recognize target and access to relevant data. First the reader sends RF signal of specific frequency, the RFID tag will produce induced current when it comes into the work area of transmitting antenna, and then chips on the RFID tags will be activated, next RF tags send out their own information through the built- in antenna, when the antenna of the system receives the carrier signal sent by the tag, it will transmit to the reader by antenna controller.

Reader layer: RFID reader is wireless transmitter / receiver set with antenna, for sending and receiving radio signal, which are able to read/write operations of RFID tag. It is mainly composed of two basic functional blocks: the control unit and RF interface, which is characterized by strong computing capability and large storage space. Readers system will demodulate and decode the RF signal received from the tag layer, and then send via the internet to the application system for appropriate processing.

Internet layer: in the systems of RFID-based Internet of Things, communication is via radio signals between the tag layer and reader layer, and via the internet between reader layer and application system layer.

Application system layer: the main function of application system layer is to establish practical application in all industries by integrating all functions of underlying systems, such as in the fields of intelligent transportation, item identification, electronic tickets, anti-counterfeit of commodity, urban intelligent management, identification, agricultural food management. Since application system generally includes back-end database systems, which is mainly used to store the information of RFID tags, this system is required to have strong computing power and large storage space.

5 APPLICATION OF SYSTEM OF INTERNET OF THINGS BASED ON RFID TECHNOLOGY

Owing to its uniquely identifying characteristic, RFID tag has sparked the interest of people in the application study on RFID-based technology, and the Internet of Things has been a study hotspot at present. In recent years, study and applications of RFID have accelerated the pace in China, as the national informatization pilot list released by the National Development and Reform Commission in 2009 contains RFID project involving a number of areas such as production, manufacturing, logistics, warehousing, transportation, food security, mobile payment, special equipment, electronic toll collection (ETC), the Internet of Things is getting closer to our lives.

The Internet of Things is widely used in many fields, for example: in the municipal operation and management, it is used to monitor conditions of key infrastructure such as water, electricity, heat, gas and underground pipelines, thereby improving the municipal management level, it is also used to take hold of situation of various types of vehicles and personnel by means of video surveillance, sensor, telecommunication system and Global Positioning System (GPS) etc.; in the fields of agriculture and food processing, via unified RFID and database system, the Internet of Things can establish agriculture by-products and food traceability system so that concern of the real-time and dynamic information are realized and any problems that arise are handled in a timely manner; the Internet of Things may also be applied in the transportation area, using modern information technology to realize the real-time monitor of traffic conditions, automated toll of road, intelligent parking and real-time online GPS vehicle tracking; in the medical field, the Internet of Things may perform

the functions of medical supervision, drug administration, medical electronic records management, monitoring of plasma collection, etc. Furthermore, the Internet of Things also plays an important role in the public health emergency management, home remote control, telemedicine, security monitoring, etc, which greatly improves the quality of life.

6 EXISTENT PROBLEMS IN THE DEVELOPMENT OF THE INTERNET OF THINGS

At present, the Internet of Things still has some urgent problems which need to be resolved although it has made our lives easier.

1) Standard Problem

First, because the Internet of Things is related to wireless transmission that has lots of transmission protocols, it is inevitable to integrate these protocols for a more effective use. Second, there is no standard architecture generally accepted for Internet of Things so far, and lots of protocols have no common interface either. Such problems have hindered the development of the Internet of Things.

2) Price Problem

Owing to the higher cost of production of chips for the Internet of Things at present, it is unrealistic to attach this kind of identification chips with high cost to all items. Moreover, the transformation of existing products to meet the requirement of the Internet of Things also has a relatively high cost and needs huge investment. However, as the development of technology and industrial upgrading of industry of things of internet, the cost will continue to decline gradually.

3) Security Problem

Since the small-sized items accessed to the Internet of Things can not carry the higher frequencies, more secure application can not be achieved. Furthermore, due to the wide varieties of items attached on the Internet of Things leading to close connection and large amounts of data and personal privacy transmitted over the Internet, the chief problem is to ensure these information not be cracked among the obstruction of the development of the Internet of Things.

4) Problem of Policies and Regulations

Since the Internet of Things involves all kinds of industries which need to be integrated, the state is required to formulate the policies and legislation suitable for this industry growth so as to guarantee its normal and order development

7 CONCLUSIONS

With consideration of the above problems, the Internet of Things needs to be developed energetically by improving the relevant laws and regulations as soon as possible, setting up uniform standards and specifications, working out a set of RFID standardization system, increasing the study on the security of RFID, following the development principles “with the application as the driving force, technology as the core, and standardization as the safeguard” so as to promote the whole industrial chain development of the Internet of Thing.

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