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Multi-terminal data integration analysis of internet of things based on middleware[1]

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Abstract. With the emphasis on environmental protection in China, the development of electric vehicles in China is getting bigger and stronger. However, traditional electric vehicles still have the problem of mobile terminal positioning, which is not only inefficient but also low in reliability. Therefore, in order to solve these problems, in this paper, the method of multi-terminal data integration analysis of Internet of things based on middleware was proposed, and the network physical structure of charging station of electric vehicle was constructed. By adjusting routing configuration and topology structure, the design of the middleware of the electric vehicle charging station network was completed. Through the simulation test, it can be seen that the system has the function of fast locating and searching electric vehicle charging station by means of mobile terminals, which specifies a number of data for the mobile terminal device, and has good data integration performance.

Key words. Internet of things, middleware, electric vehicle, RFID technology.

1. Introduction

In order to provide effective information for mobile terminal equipment, this paper explored that how to locate and search the electric vehicle charging station with the help of mobile terminal, and solved the problems of charging pile navigation, communication and fast positioning during the use of the electric vehicle. With the help of gateway equipment, including the Internet of things, sensor networks and mobile Internet network and other network interfaces, wireless sensor networks are

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integrated with the Internet to solve heterogeneous network convergence issues after accessing the Internet through the use of design gateways, which provides charging pile navigation and communication technology support for electric vehicles [1]. This paper described the traditional electric vehicle mobile terminal positioning problem. With the RFID technology as the breakthrough point, this paper discussed the non-contact automatic identification technology, improved the algorithm and design level of traditional problems, such as low location search efficiency and poor data integration performance. In the charging station search, this paper entered the low frequency transmitting antenna area through the RFID card, and designed the method of multi-terminal data integration analysis of Internet of things based on middleware, discussed the system construction and hardware model design and the problem of Internet of things gateway from the following two aspects: With the help of gateway technology, software platform design and hardware platform design can complete the task of heterogeneous network integration of cloud computing, and achieve the goal of data fusion of the information resources of the electric vehicle charging station, can highlight the good performance of the equipment in the process of system testing, so as to better serve the owners of electric vehicles.

2. State of the art

Since 2005, the International Telecommunication Union (ITU) has proposed "ITU Internet Report 2005: Internet of Things", the report formally declared that the Internet of things is an extension of Internet applications, the following core technologies can achieve the Internet of things: RFID, Sensor technology, intelligent embedding technology and nanotechnology [2]. In 2009, IBM proposed the concept of "wisdom of the earth", many countries incorporated the Internet of things into the strategic system for future information development [3]. Up to now, the world has not made a unified definition of the Internet of things. The European Internet of Things project research team argues that the Internet of Things is an important part of the Internet, belonging to a dynamic global network architecture that contains self-organizing capabilities for communication protocols [4]. Physical and virtual "objects" include features: physical attributes, virtual properties, identity, and it can be applied to the information network [5]. The definition of the current setting of Internet of things: With the help of various information sensing equipment, including the integration of global positioning system, laser scanning, infrared sensor and RFID device with Internet, it constitutes a huge network, the main objective is to make the network accessible to all objects, which improves the efficiency of management in the process of integrating identification resources. In the Internet of things, "CPS" "M2M" belongs to the key application forms [6].

3. Methodology

3.1. Internet of things technology

In the current environment, the Internet of Things is used in many fields, including logistics sales, intelligent transportation, public services, furniture life, environmental monitoring and so on, involving industrial agriculture and logistics industry and other fields. Among them, smart grid is one of the key fields of Internet of things [7]. Power transmission and transformation equipment has many characteristics as rich species, large quantity, which makes the equipment information sources more abundant. The access methods are also different. At the same time, the equipment evaluation and decision making technology is uneven, which brings a series of influence to the operation state of power transmission and transformation equipment, and makes the operation safety of power grid be impacted to varying degrees. According to China's data grid report, since the 21st century, due to natural disasters and equipment failure problems, the grid accident rate increased significantly. The use of Internet of Things technology can effectively reduce the risk, reduce the irrationality of equipment condition maintenance, help the equipment to achieve the goal of optimal management, improve the detection performance level of substation equipment and standardize the standard detection framework [8]. For the power transmission and transformation equipment of Internet of things, it is closely related to information space and physical space and belongs to the extension of the smart grid in the intelligent environment of the equipment. For the Internet of things, by using intelligent perception technology, it can improve the efficiency of on-line monitoring of equipment and solve the demand of smart grid for equipment status data. As shown in Fig. 1, the modern Internet of things technology connects all fields to integrate communication, so as to carry out information exchange and management. The standardization construction function in the Internet of things technology makes the information model of power transmission equipment more scientific, which is of great significance to the scientific framework of the grid, and has a positive impact on the integration of the information system and detection system of power transmission and transformation equipment, so as to better serve the equipment [9].

ITU Internet pointed out in its report in 2005 that the Internet of things covers four key application technologies, namely, RFID technology, sensor technology, intelligent technology, nanotechnology, its functions include tagging things, perceiving things, thinking about things, and reducing things [10]. The research center of Internet of things technology in China focuses on communication network technology, information processing technology and perceptual identification technology. The extension application of Internet of things is based on perceptual identification technology, which can sense and identify a range of data, including components such as radio frequency identification, smart sensors, electronic code, and two-dimensional code [11]. For the communication network technology, its role is to enhance the realization of perceived identification information reliability, to build a more secure transmission environment. The network covers the wireless self-organizing network,

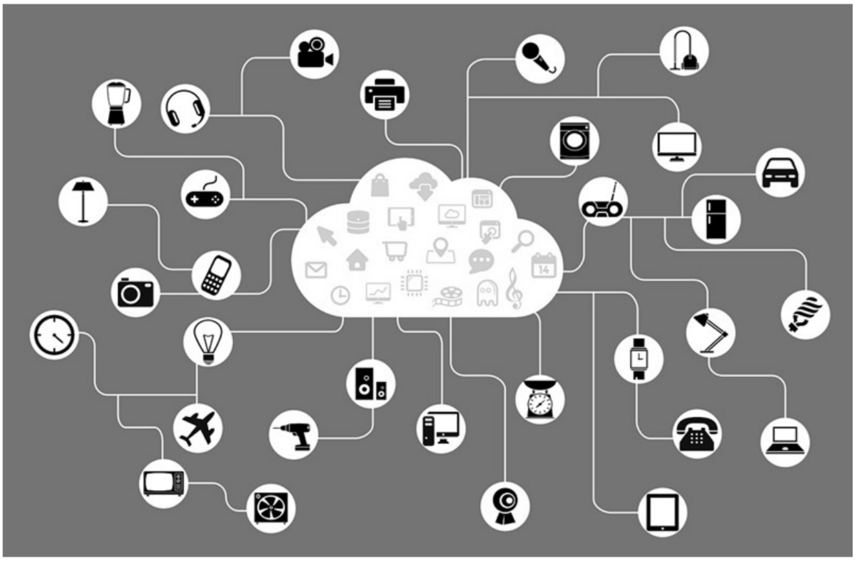

Fig. 1. Sketch map of modern Internet of things

the sensor network, the next generation network with the Internet protocol version as the core. In terms of communication technology, it mainly involves ultra-wideband, global microwave interconnection, Bluetooth, wireless fidelity, near field communication, 3U and so on. It is necessary to deal with more difficulties after expanding the scale application of Internet of things, including: data storage, information fusion, information mining and knowledge update. The Internet of things is an information processing technology based on cloud computing, which is based on efficient use of information [12].

With the rapid development of smart grid, non-renewable energy is becoming increasingly depleted. The important components of the smart grid construction, such as the new distributed energy of electric vehicles, can meet the demand for the rational use of energy in time by adjusting the price and peak shaving of the power grid [13]. The application of IT technology in the Internet of things in electric vehicles will enable them to play an important role in rechargeable batteries, charging facilities and electric vehicles. In addition, the use of smart sensors can help cities achieve full coverage. The Internet of things has a series of advantages, including low investment cost, extensibility, flexibility and applicability of network topology. The application of Internet of things technology in the charging facilities can give full play to the advantages of dispatching and make the metering and accounting functions scientific and reasonable. In the configuration of intelligent sensors for electric vehicles, it sets the electronic tag, which can transfer data messages to the charging facilities scheduling platform by means of Internet of things wireless technology. The platform is based on the following issues: car operation status, the number of electric vehicles charged, the use of charging facilities and so on, so as to improve service efficiency [14]. This paper designed the main controller of the system as S3C2440 module, interface circuit, 485 network and Ethernet communication-based interface circuit, made many improvements to the multi-terminal data integration algorithm, and finally completed the data integration goal of the multi-terminal of the electric vehicle charging station information resource.

3.2. Construction of network physical architecture for electric vehicle charging station

When the electric vehicle enters the charging pile area, the owner of the electric vehicle uses the electronic tag, and the reader in the charging station can automatically scan the identity and basic information of the user, including personal name, identity card number and telephone and so on, while sensing the corresponding battery charge information. This information will be automatically transferred to the automatic toll collection system, and then the charging charge will be measured. The settlement center will pay automatically according to the value, and will obtain the consumer information on the user's SMS with the form of short message. With the help of Internet, users can query their personal account information. Internet of things not only has the charging facilities management functions, but also has a series of advantages in the rechargeable battery. This paper combined the different intelligent charging service network operation mode, charging assets change two issues, analyzed battery management in network operation mode and developed a series of system solutions.

Based on the perspective of multi-terminal equipment, in order to achieve the goal of resource sharing and data integration, electric vehicle charging station is set as the research subject, so that it can provide a series of services for the owners, including the search charging station, accurate positioning, searching charging pile. Based on the design of the system model, the designed electric vehicle charging station has the characteristics that in the monitoring area, the isomorphism is set as a micro sensor node with data acquisition function, at the same time, it guarantees that the communication distance, energy supply and computing ability of each node can be well coordinated. In the cloud node control environment, that is, wireless sensor network, efficient algorithm is used to make the adjacent nodes trust each other by monitoring the behaviors of two adjacent nodes, so as to obtain the comprehensive trust value after tradeoff. In the process of loop computing, the communication link data of wireless sensor networks can be assigned a series of tasks. At the same time, the transmission results can be sent to the data to achieve the purpose of data transmission and distribution. Based on the above principle, the structure of the physical system of the electric vehicle charging station in the framework of the Internet of Things system is shown in Fig. 2.

According to the above principles, the electric vehicle charging station network physical architecture is constructed. In this paper, the middleware technology is used to complete the following contents: the heterogeneity of charging station network, hierarchical structure design, some common functions of the business layer based on sensor network infrastructure. The hierarchical structure and heterogeneity of the charging station for electric vehicles are shown in Fig. 3. As shown in Fig. 3, the use of network middleware technology can achieve the following service functions:

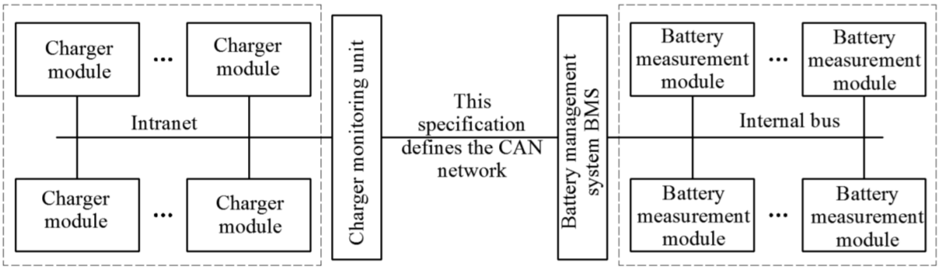

Fig. 2. Station network physical architecture of electric vehicle charging

network generation services, network connectivity services, wireless sensor network access services and network self-healing services. Middleware can be used as the carrier to transmit interactive messages. It is worth noting that the node of the key way of completing middleware is information transmission. Applications can be applied to the OS environment and multiple platforms through middleware.

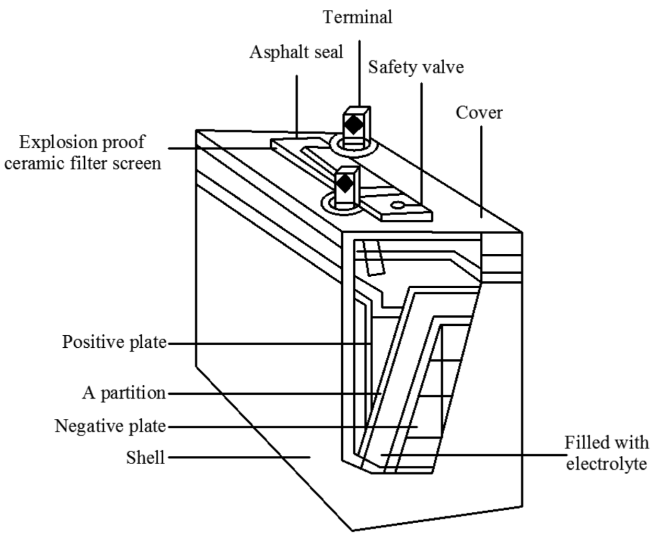

Fig. 3. Heterogeneous and hierarchical structure of electric vehicle charging station network

3.3. Heterogeneous network hierarchical data fusion model for electric vehicle charging station

In this paper, the NES C design idea is used to construct the heterogeneous hierarchical data fusion model of the charging station network. The component takes the connected interface as a carrier, and describes a set of functions command() and event() in the gateway structure, among them, the former is provided by the interface provider, and the latter is implemented by the interface user. Components have the function to implement the logic function module, which belongs to the basic unit of the program NES C. In the whole Tiny0S node, many components constitute a program. In the electric car charging station, Fig. 4 shows its network node application program and communication hardware design and module design system.

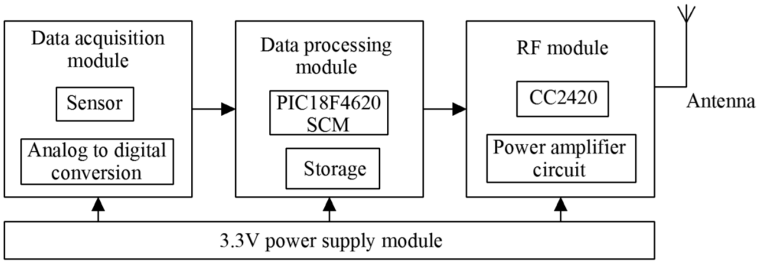

Fig. 4. Station network heterogeneous hierarchical data fusion diagram of electric vehicle charging based on Tiny0S

4. Result analysis and discussion

Through the hardware module synthesis, this paper puts forward the concept of multi-terminal data integration algorithm, and used the gateway technology to achieve the goal of cloud computing heterogeneous network convergence, and dealt with the following problems: the real time and validity of network transmission, data integration strategy. In order to improve the efficiency of network data transmission, this paper proposed an access algorithm to enable heterogeneous network networks to improve problem processing efficiency during convergence. For the algorithm design, it is described as follows: by using the above-mentioned branch situation, the number of scheduling task instructions is predicted. After the terminal data integration analysis, the number of scheduling task instructions is measured by the corresponding formula. In this formula, $p(q|e)$ is mainly used for the description of the time interval, so that the distribution of q is more logical, δ is a collection that consists of the total number of location instructions in the charging station, this formula is used to complete the description:

$$\delta = \{q\,|el + 2eq \leq q \leq Q\} \tag{1}$$

Among them, based on the middleware task in the Internet of Things, Q is the maximum value of the allocation period. According to the above algorithm, this paper used the network technology to integrate and realize the heterogeneous network of cloud computing, so that multi-terminal of information resources for the electric vehicle charging station achieved data integration, and met the requirement of fast and accurate positioning of the electric vehicle during the use, meanwhile, it dealt with the navigation and communication of power station, charging pile.

In order to test the design proposed in this paper, from the perspective of multi-terminal data integration of Internet of things based on middleware technology, this paper tested the performance of data gateway terminal fusion, that was, the location and search performance of electric vehicle charging station. Firstly, the gateway serial port based on middleware technology was constructed. Computer gateway port was taken as a carrier, telos B node and another telos B node were connected, a data was output every 1 s, and the search for the electric car charging station was completed. According to the simulation background design, the search positioning and data integration function of the electric car charging station was completed. The serial port debugging tool software allowed the system to output interface data after completing multi-terminal data integration, as shown in Fig. 5.

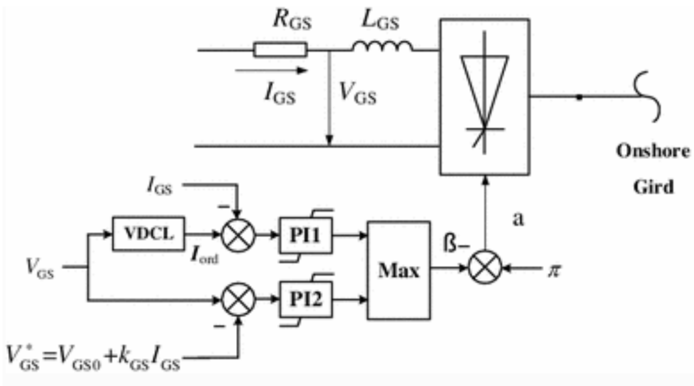

Fig. 5. Multi terminal data integration analysis results

The results of the data location experiment of the charging station of the electric vehicle in city A are shown in Table 1.

Table 1. Station data information localization results of electric vehicle charging in city A

Number	Real data location	Traditional algorithm results	Algorithm results in this paper
1	(21, 48)	(22, 49)	(20, 47)
2	(46, 35)	(49, 36)	(49, 35)
3	(56, 73)	(55, 75)	(54, 74)

According to the results of data integration described in Figure 4 to charge high search station detection, assuming the charging station distribution area belongs to random distribution, on the basis of cloud computing in heterogeneous network proposed fusion principle, can realize the fast charging station coordinates, during the search for the best navigation, take the mobile terminal fast positioning function to search for electric vehicles the charging station, by mobile terminal equipment can obtain effective information, after a series of testing system can obtain different charging city of A in the simulation environment the station coordinate map, we conducted a total of three positioning experiments, as shown in Table 1, the actual position location respectively (21, 48), (46, 35), (56, 73), and the traditional positioning method for the position (22, 49), (49, 36), (55, 75), by using the method of this paper is (20, 47), (49, 35), (54, 74), obviously, this method is more close to the true position, positioning is more accurate, complete data integration in the mobile terminal, can effectively improve the charging station location coordinates positioning accuracy, guarantee the precision of navigation, the networking gateway designed load balance display in this paper, the Balanced Routing system has higher, reflecting the data integration and network communication function, so as to electric vehicle charging pile in navigation and communications to provide technical support.

5. Conclusion

The use of smart sensors and electronic tags in the charging station can sense the position and running state of the electric vehicle in real time, which helps the owner understand the performance of the rechargeable battery profile. When the charging facilities have problems, the deficiencies can be solved in time. In this paper, the rapid positioning of mobile terminals and the search of electric vehicle charging stations were discussed, so as to provide service information for mobile terminals and effectively solve a series of problems for owners in the use of electric vehicle, including rapid positioning, charging pile navigation and communication. In this paper, the method of multi-terminal data integration analysis of Internet of things based on middleware was proposed. System construction and hardware model were designed and analyzed. From the point of view of software platform design and hardware platform design, the Internet of things gateway was analyzed, the convergence goals of cloud computing heterogeneous networks were accomplished by relying on network management techniques, the multi-terminal data integration of information resources of long power station of electric vehicle was realized. According to the system test, the multi-terminal data integration system of Internet of things of the electric vehicle charging station designed in this paper can locate and search the coordinates of the charging station, and improve the efficiency of network communication and data integration, which makes it easier for the owners of electric vehicles to finish rapid positioning, charging pile navigation and communications during the use. Of course, the results of the study also reflect the room for further improvement. Therefore, the lack of continuous improvement research is a weakness.

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