Optimization of Information Perception and Interaction Technology of Internet of Things

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Abstract

Information perception serves as the basic function in Internet of Things. The Internet of Things is the basic means of information exchange through the comprehensive perception of information, so as to achieve the purpose of material interconnection. In recent years, researches on the Internet of Things have become hot topics, which have further integrated the information perception technology of the Internet of Things with interaction technologies. In this paper, the information perception technology and interaction technology of Internet of Things are discussed; and a system model based on the integration of information perception technology and interaction technology is constructed. Analyzing the optimization of the system model aims to achieve the optimization of information perception technology and interaction technology of the Internet of Things.

Keywords: Internet of Things, Information Perception, Interaction Technology, Optimization Research.

1. RESEARCH BACKGROUND

1.1 Research summary

The development of information technology has brought about a major change in Internet of Things, which is known as the third wave of the information industry. It is said that Internet of Things is another extension of the Internet, which realizes the sharing and exchange of information with the perception and collection of the object information through a variety of information perception devices, that is, the perception object will be connected to the internet based on the agreed protocols. Therefore, the fundamental purpose of information perception of the Internet of things is to achieve the information exchange and communication, which is the process of information interaction consistent in its purpose, thus fully realizing the integration of information perception and interaction technologies. In recent years, many scholars have conducted many researches on the Internet of Things. Some scholars have integrated the Internet of Things information perception and interaction technology, in order to build an intelligent context-perception interaction system, to explore the feasibility of the integration of information perception and interaction technologies and to prove the value of the application of such system in smart power grid (Li et al., 2016). Some scholars also discuss the contents and relevance of information perception and interaction technologies, analyzing the important role of information perception and interaction technologies in the Internet of Things (Liu, 2017).

1.2 Research purposes

The paper aims to explore the technology of information perception in the Internet of Things in details, to analyze the application of the key technologies such as data collection, cleansing, compression and Integration in technology, and to clarify the importance of interaction technology and interaction manners in the Internet of Things (Zhou, 2017). By proposing a system model that integrates information perception technology and interaction technology, the application value of information perception technology and interaction technology in the Internet of Things are further clarified. In view of this, the relevant optimization strategies on the information perception and interaction technology are deeply studied.

2. INFORMATION TECHNOLOGY OF INTERNET OF THINGS

2.1 Data collection
Data collection is an important technology of information perception in Internet of Things. It collects and processes collected data through perception nodes. It is mainly used to collect and process various types of data. The constraints of network latency, throughput, and efficiency also make the reliability of data collection a crucial issue (Jia, 2017). At present, China mainly improves the reliability of data collection by multipath transmission and data retransmission techniques. However, these techniques all have some limitations. Multi-hop transmission is a multi-hop routing method for data transmission. So that it may lose packets every hop during data transmission (Fu and Xu, 2016). There are some limitations of the data retransmission technology storage space for data collection. In the process of data collection, the problem of network delay should be emphatically considered. Node hibernation is usually used to reduce the energy consumption of nodes during data collection. Sleeping nodes dormancy can effectively reduce the network load of data collection and transmission, thereby shortening the transmission time, in order to achieve the uninterrupted data collection and transmission.

2.2 Data cleansing

In the process of data collection, there are abnormal data due to the influence of the change of network environment and other environmental factors. Thus cleansing the abnormal data can greatly improve the accuracy of the data. Data cleansing technology, such as the temporal and spatial variation of data, using probability statistics and classification methods, help the data cleansing and processing. In data cleansing, the classification and identification method is the most commonly used. It obtains the outliers of data through Bayesian network or SVM, and then determines the outliers by the historical data in the nodes. It makes use of Bayesian Computation to draw accurate judgments on outliers (Liu, 2016). In addition, the classification and identification method can also analyze outliers and existing value of data according to different data information, and correctly identify and cleanse the missing values to ensure that the collected data are kept intact. Due to the more complicated operating environment of Internet of Things with more influential factors, data eradication methods are also greatly limited (Ma et al., 2016). Therefore, data cleansing should first solve the problems, such as the network energy consumption and load balancing and other related issues, in order to achieve large-scale data cleansing.

2.3 Data compression

In the data transmission process, the user information needs and its own variability makes the entire transmission process becomes extremely complex and makes it difficult for the Internet of Things system to carry large amounts of information and data. However, in order to achieve the reliable delivery of information, it is necessary to compress the information data, in order to ensure that the database can accommodate more information data, known as the data compression technology. Data compression technology is also one of the information perception technologies. The data compression technology used in the current Internet of Things system mainly function as sorting the data (Yang, 2016). However, due to the constantly changing information and the continuous development of science and technology, it is more and more difficult to sort the data, which can meet the development of the times. Therefore, only the constant innovation and optimization of data compression can get rid of all kinds of shortcomings regarding the traditional data compression technology, which will make the data compression technology attain more attention from the Internet of Things.

2.4 Data integration

In the Internet of things, the collected data and information are distributed, which makes the statistics and analysis of the data difficult. Therefore, the data can be processed efficiently when the data is processed accordingly, known as the data Integration technology. Data Integration technology is to integrate and to screen the data collected in different nodes. It restores and rearranges the data based on the data cleansing technology, thus ensuring the accuracy of data and reducing transmission pressure on the Internet of Things system (Zhang, 2015). Data Integration technology mainly includes three levels of integration, namely data layer, feature layer and decision-making layer. Data layer analyze the collected data based on the needs of the Internet of Things, deleting useless data, and both the feature layer and decision-making layer are to integrate the information.

3. INTERACTION TECHNOLOGY

3.1 Information interaction model of Internet of Things

System and user and information are the three major components of interaction technology, as well as the interaction subject in interaction technology. Users need access to information through the operation of the system,
while the system contains a large amount of information and data, which makes the system a carrier of information to display different information (Yang, 2016). According to the relationship among users, information and systems, and integrated with the characteristics of Internet of Things, an information exchange model of Internet of Things is constructed as shown in Figure 1. The information interaction model is composed of system, user and information. It differs from the traditional information exchange model in terms of user meaning. The users in this model include not only human-computer interaction users but also cluster head nodes, network nodes, routing nodes and sink nodes (Zhao et al., 2017). The system represents the information perception network itself, which contains computing units and storage units, information perception unit and energy unit; the information represents the content generated during the interaction, including various objects’ perception information and status information. The information interaction model of the Internet of Things essentially reflects the interaction between users, systems and information (Liu, 2017).

![Figure 1. Internet of Things Information Interaction Model](image)

### 3.2 Interaction between users and network

In the Internet of Things system, the process of contact between people and things is the most complex and basic. The complexity lies in the contents produced by the interaction between people and things with complex and diverse forms. The basis is that people’s control and operation of the system can have broader application of the Internet of things. It can be said that the process of contact between people covers the process of information collection, the compression and integration of information, which is the integration process of many data technologies in information perception technology. In this process, users can send instructions to the Internet of Things system for the data filtering and processing, and ultimately the results will be returned to the user.

### 3.3 Interaction between contents and network

The process of interaction between content and network is that users understand the network information through the system, which includes both the storage of information and the integration of information (Xue, 2014). Among them, information storage is the most important for the Internet of Things is an extension of the network. It can be said that the Internet is the foundation and core of the Internet of things; in the interaction process a large amount of data will be produced, which greatly occupy Internet of Things system space causing data storage limit of the Internet of Things. Currently, data storage is mainly divided into two forms, external storage and internal storage respectively. However, it is increasingly difficult for the two storage forms to satisfy the needs of huge data storage. Therefore, the way of storage of Internet of Things will inevitably change and obtain more and more distributed data storage in the near future, which will further improve the system operation efficiency of the Internet of Things.

### 3.4 Interaction between users and contents

The interaction between users and contents is to use of Internet of Things endpoint for data transmission, and later users have to find data to their own needs from a huge database. This will require a platform of the Internet of Things system that allows users to interact with content (Ling and Zhuang, 2015). Users can collect the required data within the shortest possible time through the platform. When users collect data, it is difficult to accurately input the content of the information they need. However, the Internet of Things system can collect the information related to it through the character input, which allows users to choose the data of these associated information. It can be said that the interaction between user and the content makes the Internet of Things become more intelligent.
The current Internet of Things information query can already be collected by the way of voice recognition. The user only needs to say the data he needs and the Internet of Things automatically collects all the data content related to the user's needs, thus greatly improving the application efficiency of the Internet of Things system.

4.OPTIMIZATION OF INFORMATION PERCEPTION AND INTERACTION TECHNOLOGY OF INTERNET OF THINGS

4.1 Optimization of system framework

In the Internet of Things, various information devices, such as sensors, make the connection between objects more complicated, which also makes the user the sole executor of the system no longer. Moreover, if user does not operate and control the system, interaction between the objects can trigger the system (Xie, 2015). As it known to all, the Internet of Things environment poses an upper limit on the energy consumption of system equipment, and the bandwidth is in real-time changes. However, the use of new equipment is bound to cause major changes in the system’s interaction environment. Therefore, this paper presents a intelligent interaction system constructed by the Integration of information perception technology and interaction technology. The system can realize the autonomous operation of the user with automatically collecting, detecting and processing the related information data, such as the change of the current voltage and the operating status. Figure 2 shows the information perception and interaction technology of the system framework.

Figure 2. Schematic Diagram of Information Perception and Interaction Technology System

As can be seen from Figure 2, in the system framework, both the object and the user can interact with the information through the framework. The system can sense the object information. People can modify the system rules to make the system adapt to changing interaction environment. It is concluded that building the system through the integration of information perception and interaction technology, which can improve the system of Internet of things with strong adaptability.

4.2 Optimization of integration model and integration method

In the Internet of Things environment, in the integration process of the information perception technology and interaction technology, the Integration model is the most critical issues of the integration process. The information sensed by the system and the way to describe these sensed information are all the issues that need to be considered in the process of establishing the integration model. Theoretically, almost all information may be perceived information, but in fact not all information can be system-perceived. The traditional information perception and interaction technologies are realized through human-computer interaction. The user-centered principle is to realize the perception and collection of information. Therefore, the scope of the perceived information is
expanded. The optimization of the integration model can achieve the interaction between users, systems, objects, in order to achieve a high degree of integration of information perception technology and interaction technology. Figure 3 shows the optimized integration model of information perception and interaction technology.

\[ P(x_i/C) = \frac{P(C/x_i)P(x_i)}{\sum_{j=1}^{n} P(C/x_j)P(x_j)}, \sum_{i=1}^{n} P(x_i) = 1, \sum_{j=1}^{n} P(C/x_i)P(x_i) = \sum_{j=1}^{n} P(C,x_i) = P(C) \]  

where \( P(x_i) \) represents the probability of the production of \( x_i \), \( x_2 \), \( x_n \) regarding Event C. In the formula, the known fact is the true prior probability regarding \( x_i \). \( P(x_i/C) \) represents the hypothesis of the true posterior probability of \( x_i \) with the condition of the existence of target \( i \) regarding the given evidence C. If \( x_i \) is true, the probability occurrence of the observed evidence \( C \) \( P(C/x_i) \) is obtained, and \( P(C) \) represents the prior distribution density of C.

Bayesian estimation method can integrate the data obtained from the perception device in the system and the acquisition device of the system, and calculate the true posterior probability of the given hypothesis. Suppose there are different qualitative sensors in the system for sensing the same objects. If there are \( m \) properties of the object need to be perceived, there are \( m \) proposition \( x_i \) \( (i = 1, 2, ..., m) \). There are mainly 4 steps in the integration algorithm of Bayesian estimation algorithm. First, the data perceived are classified according to the characteristics and attributes of information, and \( C_1, C_2, ..., C_m \) represents the attributes. Second, the likelihood function of the evidence in each sensor under the true condition is assumed, and calculated of the true posterior probability of each hypothesis according to the Bayesian formula. Finally, the logic is judged to obtain the conclusion based on the generated attribute.

4.3 Optimization of information perception and interaction technology and equipment self-adaptation

As the equipment of the Internet of Things may be updated or commit errors in a state of real-time change, how to improve the device self-adaptation capability after the integration of information perception and interaction technologies has become an important issue in the integration of information perception technology and interaction technology. Therefore, corresponding measures need to be taken to optimize the adaptability of the equipment. \( S \) is calculated based on \( S = S_1, S_2, ..., S_M \), where \( M \) represents the number of facets, \( S_M \) represents Facet M. The sensed information element NCT is obtained based on the influence of the equipment types and information perception on the interaction. In fact, all sensed information element NCT can influence \( S \) in their own ways. Therefore, it needs to predetermine the influence weight \( Q \) of the sensed information element, and determine the influence \( E \) of the information perception of Internet of Things on the information transmission.
quality among the facets based on adaptation strategy $E = Q \times NCxt$. The above steps are used to optimize the self-adaptation calculation, which can greatly improve the self-adaptation ability of the equipment.

5. CONCLUSION

All in all, the Internet of Things further expands the scope of information exchange between people, and realizes the information exchange between people and people, people and things, things and things. It also enables the realization of the comprehensive integration and penetration of human society, the physical world and the information space. Internet of Things has promoted the harmonious development between man and nature to a great extent, which also allows a very broad space for development for information industry. In the near future, the integration of information perception technology and interaction technology of Internet of Things will surely be deepened, which will inevitably promise a more rapid development of the Internet of Things.

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