Research on Communication Information Fusion Method of Multi-source Heterogeneous Sensor Networks in the Background of Internet of Things

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Abstract: Multi-source heterogeneous sensor network communication information fusion is the representative of social progress, but the existing traditional methods are not accurate and low efficiency, so the multi-source heterogeneous sensor network communication information fusion method in the context of Internet of Things is proposed. The communication information fusion method of multi-source heterogeneous sensor network is designed. The method of acquiring multi-source heterogeneous sensor network communication information in the context of Internet of Things is studied and attribute calculation is performed. The effectiveness of the algorithm is analyzed, and the communication information fusion of multi-source heterogeneous sensor networks in the context of Internet of Things is completed. Finally, the simulation method is compared with the traditional method. It is found that the accuracy of this method is 15.3% higher than that of the traditional method in the communication information fusion of multi-source heterogeneous sensor networks.

Keywords: Internet of Things; Multi-source heterogeneous sensing network; Communication information; Fu sion

1. Introduction

The Internet of Things is considered to be another big leap in the field of information technology since computer technology and Internet technology. Due to the huge application potential in the food industry, intelligent transportation, retail industry, logistics support, medical and health industry and smart home, the Internet of Things has quickly become a hot research topic in the world. With the rapid development of intelligent sensing devices, sensor manufacturing processes and communication technologies, a large number of sensing devices have been connected to the Internet. And data information is continuously collected and transmitted through the network, so that the Internet of Things has a large variety of perceptual data information. The Internet of Things is transitioning from a "physical network" phase of objective object monitoring based on various types of intelligent sensing devices and their communication networks to a "virtual resource network" stage that reflects data objects and states [1].

2. Design of Communication Information Fusion Method for Multi-source Heterogeneous Sensor Networks

With the rapid development of the Internet of Things technology, more and more objective things and cognitive smart devices are connected to the Internet, and a large amount of Internet of Things data is generated, transmitted and stored. The connection between objective things and the Internet, the collection and processing of perceived data, the main goal of these tasks is to achieve a better understanding of the dynamic environment of the dynamic changes, to achieve a thorough information perception, integrated intelligent services. Only by effectively integrating and integrating these Internet of Things data information can the Internet of Things achieve the goal of integrated intelligent services. Aiming at the multi-source heterogeneity of data information in the Internet of Things environment, this paper studies the communication information fusion method of Internet of Things multi-source heterogeneous sensor network. The frame diagram is shown in Figure 1. It has important inspiration and guidance for the processing flow and specification of information in the Internet of Things environment [2-3].

As an important part of the future Internet, the Internet of Things is tasked with building an infrastructure that connects and perceives everything, and builds a network that is highly connected by networks, information, services, and objective things. Therefore, the essential feature of the Internet of Things is the scale of interconnection, that is, universality. Due to the universal characteristics, the

Internet of Things data has its own characteristics. Since the Internet of Things collects data information in the form of time-characterized data streams, the amount of data continues to grow over time, and the data has a higher attribute dimension due to multi-angle perception. Due to the interconnection and information exchange of various types of sensing devices in the Internet of Things, a large amount of heterogeneous data exists in the Internet of Things. Because the Internet of Things is an observation of objective things and their changes characterized by time, there is a time dimension requirement for data. In the Internet of Things, aware device deployers at all levels perform data storage and maintenance management on their corresponding data centers. From the perspective of data evolution process and function, Internet of Things communication information fusion can be divided into four stages: information acquisition, attribute calculation, method effectiveness analysis, and information fusion. Effective use of data information in the Internet of Things is a challenge for the Internet of Things [4-5].

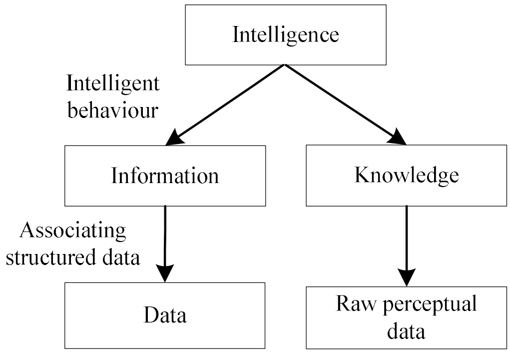

Figure 1. Evolution of Internet of Things data information

2.1. Multi-source heterogeneous sensor network communication information acquisition

The comprehensive perception of the Internet of Things technology is based on the data generated by the underlying types of sensing devices for the observation of physical world objects. These data are often only for a physical phenomenon or event, such as ambient temperature, atmospheric humidity, carbon dioxide concentration, etc., and the analog signal generated by a specific sensing device is converted into a digital signal. Then according to specific principles, further parsed into a human universal value. At this time, the data is still relatively rough data. Under normal circumstances, it does not fully reflect the meaning that humans or machines can understand. These data are often stored and maintained in a distributed manner by the deployer of the observing device. Information acquisition is a cyclical process that can be called a fourth-stage system performance assessment to identify new sources of information that may be valuable, and it is important throughout the information processing process. As shown in Figure 2, the multi-source heterogeneous information acquisition of the Internet of Things is an overall diagnostic interpretation of the information fusion process that adapts to the characteristics of the Internet of Things, and has an important guiding role [6-7].

The corresponding observation semantic description model is customized for the attributes of these collected data. Then, according to the corresponding pattern layer description model, the original data collected by the bottom layer of the Internet of Things is connected with the metadata annotation and the associated data, and the mapping is performed in the instance form and the pattern layer description model to realize the abstraction from observing the original data to the observation information [8-9]. In the Internet of Things environment, it is hoped that without the knowledge of a priori experts, the relationship between certain things can be mined and found from multi-sensor data, and the information acquisition rules can be extracted, thereby completing the fusion of data and assisting decision-making. In the process of completing the information rule extraction, the most critical task is the feature selection, that is, the attribute is simplified. Feature selection can remove redundant feature attributes while maintaining the recognition ability of the original feature attribute set, thus obtaining a simple information acquisition rule [10-11]. The information acquisition method is analyzed, and the analysis of the original data collection is shown in Figure 3.

As can be seen from Figure 3, in the sensor network environment, due to various reasons such as communication delay, system failure, sensor network node damage or energy problems, it leads to the occurrence of many data values in the timing-based multi-sensor network data information system [12].

2.2. Information attribute calculation

The attribute calculation for the acquired information completes the information fusion is the key to the communication information fusion method of the Internet of Things multi-source heterogeneous sensing network [13]. Given a source of information $S=(U,A)$, the discriminant matrix $M(S)$ under the equivalence relation is a matrix of $|U|*|U|$, where the matrix element $M_{ij}(S)$ is defined as:

$$M_{ij}(S)=\{a|a \in A| \wedge (a(x_i) \neq a(x_j))\} \quad (1)$$

Where, $1 \leq i$, $j \leq |U|$, , $|U|$ represents the base of U , the number of elements. Given the information system $S=(U, A)$, the discrimination matrix $M(S)$ under the equivalence relationship. If and only if there is a certain $m_{ij}(S) \in M(S)$, $m_{ij}(S)$ contains only one attribute a, then attribute a is a core attribute of attribute set A under the equivalence relationship. That is to say, in the condition attribute set A, the attribute a uniquely distinguishes between x_i and x_j . Given the information source $S=(U,A)$, the attribute set $B \subseteq A$, $\forall a=(A\text{-}B)$, the importance of the condition attribute a relative to the condition attribute set B is defined as:

$$Sig=(a,B,A,U)=\frac{|U/IND(B \cup (a))|-|U/IND[B]|}{|U|} \quad (2)$$

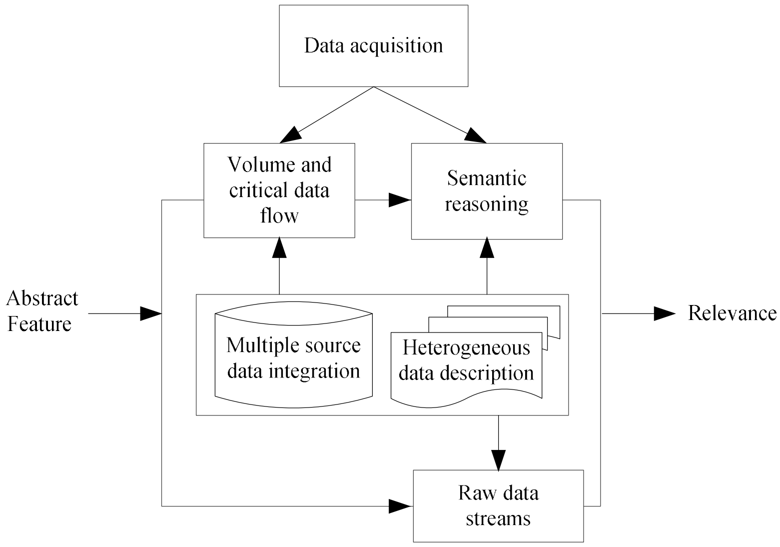

Figure 2. Multi-source heterogeneous information acquisition method

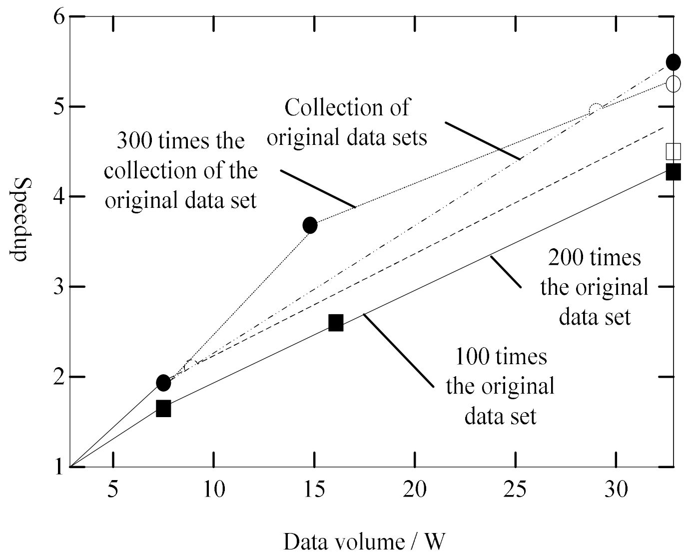

Figure 3. Raw data collection statistics

Where $|U|$ represents the base of U, the number of elements. From the above formula, we can see that if an object is included in the positive domain of the decision attribute, the kernel attribute search can be performed by calculating the distinguishing vector of the object. If we carry out search calculations in the direction of the forward granularity sequence, then as the knowledge of granularity continues to be finer, more and more objects contained in the positive domain are found. Then it means that, in the end, we can find all the attributes of the complete set of conditional properties, that is, the complete set of attributes, and finally classify the information.

2.3. Algorithm validation

In general, attribute calculation is divided into four main stages: information acquisition based on the Internet of Things background; complete set calculation of conditional attributes; information feature selection process; simplified information extraction and fusion after feature selection. First, in the normal case, the calculation of the attribute set is performed by distinguishing the matrix. In this way, the comparison of values on all attributes is done between different objects of all the universes. That is to say, all the objects X in the domain participate in the calculation of the discrimination vector and perform comparison discrimination. In the calculation of the kernel attribute under the positive approximation, only the distinguishing vector of the object contained in the positive domain needs to be calculated. In this way, the number of data objects is reduced step by step, which greatly reduces the number of objects participating in the calculation, thereby reducing the time complexity and space complexity of the computational search. Secondly, because, for a simple rule extraction algorithm, the positive domain is one of the most important parameters, and it is inevitable to perform the calculation of the positive domain in any calculation. In the calculation of the kernel attribute under the positive approximation idea, the calculation of the attribute set is also completed while calculating the positive domain. Moreover, due to the positive approximation idea, in the calculation process, the number of objects participating in the calculation of the positive domain and the kernel property will gradually decrease as the positive granularity continues to be fine. Therefore, the number of objects participating in the calculation in the domain is further reduced, and the computational efficiency is improved, indicating that the attribute calculation is very important for information fusion [14].

2.4. Information fusion

The infrastructure for information fusion is multi-sensors and networks. Information fusion is generally defined as the automatic integrated processing of data with spatio-temporal characteristics collected by several sensors under the guidance of certain rules using the computing power of the computer to achieve a comprehensive reasoning and evaluation process for specific tasks. It can be seen that the application object is multi-source heterogeneous sensor network communication information, and the process is comprehensive analysis, and the goal is to reason and evaluate according to specific requirements. That is to say, information fusion is to comprehensively analyze the multi-source data information acquired through the acquisition to ensure the reliability of the reasoning and evaluation results under the condition of ensuring a certain data quality, thereby discovering the connection between certain things. Combining various predecessors' definitions, information fusion can be understood as the use of mathematical attribute calculation methods and verification tools under certain information acquisition modes. By integrating multi-source heterogeneous information to obtain high-quality useful knowledge, the specific operation is shown in Figure 4.

When these data are used for information fusion in the communication network, under the premise of ensuring reliability, the data can be aggregated and integrated according to certain characteristics. It can reduce the amount of data transmission within the network, which is conducive to saving energy and extending network usage. In order to ensure the quality of information fusion, the original rough data needs to be preprocessed in the initial stage of information fusion, including correct analysis of data, filtering of noise data, and incomplete processing of data. Up to present, the vast majority of technological advances have been an extension of human organ function. Information fusion is also known, learned and studied by people for the same purpose. For example, a video camera is an extension of the visual ability of a human eye, and an acoustic sensor is an extension of the hearing ability of a human ear. Various types of gas sensors are extensions of the olfactory ability of a person's nose, and pressure sensors, proximity sensors, and the like are extensions of the tactile abilities that are possessed to human skin. That is to say, sensor systems deployed for the perception of objective things have human-like perceptions and even more powerful perceptual abilities for the objective world [15].

3. Experimental Argumentation Analysis

In order to ensure the effectiveness of the multi-source heterogeneous sensor network communication information fusion method in the context of the Internet of Things proposed in this paper, a simulation experiment is designed. During the experiment, a multi-source heterogeneous sensor was used as the experimental object to analyze the data acquisition and fusion of the multi-source heterogeneous sensor network. In order to ensure the effective implementation of the experiment, the traditional method is compared with the multi-source heterogeneous sensor network communication information fusion method proposed in this paper. Therefore, the superiority of the two and the practicability in the development of multi-source heterogeneous sensing networks are effectively analyzed. The experimental process is observed and recorded to analyze the experimental results.

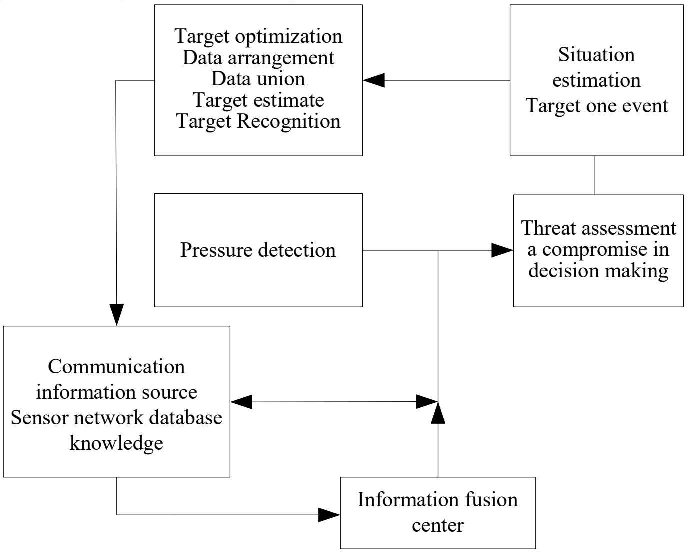

Figure 4. Communication information fusion mode

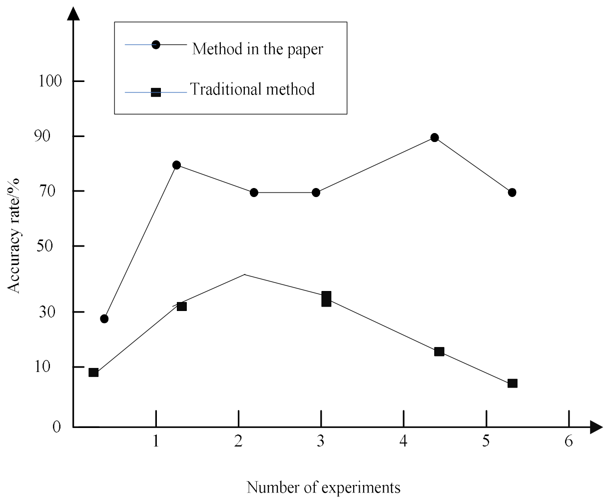

Figure 5. Data comparison chart

3.1. Experimental data preparation

In order to ensure the accuracy of the simulation test process, the test parameters of the test are set. The test object of this paper is the data acquisition and fusion of the communication information of the multi-source heterogeneous sensor network. Because the communication information fusion in different methods is different, it is necessary to ensure the consistency of external environmental parameters during the test. The experimental data setting results in this paper are shown in Table 1 and Table 2.

Table 1. Comparison of information fusion experiments

Items	Traditional information fusion method	Multi-source heterogeneous sensing network communication information fusion method
Efficiency	28 items/min	37 items/min
Accuracy rate	10.4%	25.7%
Data information volume	19	31

Table 2. Comparative analysis of information fusion second test

Items	Traditional information fusion method	Multi-source heterogeneous sensing network communication information fusion method
Efficiency	33 items/min	49 items/min
Accuracy rate	15.7%	31%
Data information volume	28	46

From the data analysis of Table 1 and Table 2, it can be seen that in the same state, the communication information fusion efficiency and accuracy are compared, it can be found that multi-source heterogeneous sensing network communication information fusion is more efficient than traditional information fusion in the context of Internet of Things.

3.2. Comparative analysis of experiments

After the above experimental preparation process is ready, the data management classification is sampled. Comparing the traditional data collection and fusion of multi-source heterogeneous sensing networks with the communication information fusion of multi-source heterogeneous sensing networks in the context of IoT in this paper, the curve analysis chart is plotted by experimental data comparison as shown in Figure 5.

As can be seen in Figure 5, in the process of sensor data information fusion, in the context of the Internet of Things, the multi-source heterogeneous sensor network communication information fusion method is 15.3% higher than the traditional method, indicating that the method is effective.

4. Conclusion

The information fusion architecture is a process of customizing the integration of data information based on the characteristics of data information, and has a global guiding role. The multi-source heterogeneous sensor network communication information fusion method in the context of the Internet of Things is considered to be a set of strategies and methods for comprehensive, accurate, timely and effective integrated information processing. Information fusion in the context of the Internet of Things is a complete framework containing theory, methods and algorithms. These theories, methods and algorithms are used to solve the communication information integration and integration of IoT multi-source heterogeneous sensing networks. Multi-perceptual devices and related knowledge information are combined, mined and comprehensive analyzed, so as to get better quality communication information.

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