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Research on Intelligent Fusion Method of Multi-sensor Data in Internet of Things

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Abstract

A huge network formed by the combination of information gathering and the Internet aims to realize the connection between things and things, things and people, all goods and networks, and facilitate the identification, management and control of the Internet of Things. In order to solve the inconsistency of various types of sensor communication protocols in the Internet of Things and the problem of data analysis, Association and evaluation of real-time multi-sensor data acquisition for different business applications, it is of great significance to develop multi-sensor protocol integration and information fusion. The method of simulating the sensor data simulates the converted data, and then according to the specific requirements of the measurement, the same type of data obtained by various sensors is converted into different physical quantities they represent. According to the theoretical analysis and ontology relationship of sensor data fusion in the Internet of Things, as well as the general method of sensor ontology intelligent fusion, the application in multi-sensor data fusion in the Internet of Things lays a foundation for intelligent control and decision analysis of the Internet of Things system.

Keywords: Internet of Things; Multi-sensor; Data Fusion

1. INTRODUCTION

The Internet of Things (IOT) is a network that intelligently identifies, locates, tracks, monitors and manages by connecting any object with the Internet through information sensing devices and in accordance with the agreed agreements and exchanging and communicating information [1]. The wireless network layer carries on the multi-sensor data acquisition terminal. Its main task is to collect data on the monitoring site, and transmit the collected data to the system server through GPRS regularly [2]. In the principle of trust degree, if the data is true, the corresponding other data will have a high degree of trust in it. Perception devices can connect to the core network through a variety of access technologies to achieve remote data transmission. Business management system is the management function of building facilities for the Internet of Things. It mainly includes various supporting systems and monitoring systems in business management, such as access control system applied to user management and security monitoring system [3]. Communication technology is mainly used in data transmission services such as network video downloading, e-mail, and VoIP, which are not required for mobile terminals. Each sensor is a source of information. For information systems, data is massive. And exponentially, the hardware and software environment that generates and stores these data is very different, so the collected data content and format are different, making data utilization and sharing a problem [4].

In terms of technology architecture, the Internet of Things can be divided into three layers: perception layer, network layer and application layer. The traditional development of multi-sensor data acquisition will develop a set of equipment management system for each sensor, and repeat the underlying repetitive work [5]. By using sensors to collect data, we can collect not only the macroscopic manifestations of the objective world, but also the microcosmic manifestations. Sensor technology is an important technology in data acquisition technology. Its function realization needs the support of various multi-sensor data systems, so it is necessary to integrate different sensors and different information sources more effectively [6]. High accuracy; multi-sensor data fusion in sensor networks; information connectivity for multiple devices and items; data communication problems between them; monitoring and control of devices or objects. The ontology contains a well-defined vocabulary that defines the relationships between concepts.

All users of the same ontology follow these definition rules [7]. The sensor nodes communicate with each other through wireless communication, and use their integrated information processing and self-organizing functions to achieve sensor node cooperation to complete the information collection of the monitored area, and finally transmit the collected information to the collection node. For further processing and feedback control. The basic operation of the master node is: initialization of the corresponding variable, and then cyclically detecting whether the data packet from the child node is received, and if the data packet is received, the analysis is performed, and the operation corresponding to the data packet is performed [8].

2. Analysis of Multisensor Data Management

2.1 Multisensor data fusion technology

Multisensor data fusion technology is to use multiple sensors to collect data from the same target, and use computer technology to analyze and synthesize the collected data to form data with high accuracy and low redundancy. Target tracking is an important technology of data fusion technology in the Internet of Things. The research focuses on how to solve the problem of complex electromagnetic interference and tracking target with high maneuverability. Nodes can transmit data. The basic work of the sub-node is to initialize the hardware and the corresponding variables first, and then to trigger the operation of sending data packets by pressing the "send key". When the key is pressed, the data packets will be sent to the main node. The range of mutual trust between the data collected by the sensor is 0~1, which realizes the feasibility of the trust degree and is easy to operate. The sensor data is more accurate after data fusion. In order to transmit the information collected by the sensor node to the external network for further analysis and processing, the aggregation node can issue the task of the intelligent gateway to the sensor node; the intelligent gateway is equivalent to the data processing fusion center, and all the sensors are used. The node information is subjected to fusion analysis processing.

2.2 Application of multisensor data fusion

The main process of multi-sensor data acquisition is that after the sensor device connects to the server, the system assigns a context class to it to record the device's information and allocate memory. Then it waits for it to send data. Peripheral perception interface and external communication interface constitute the Internet of Things terminal. Various sensor devices are connected with peripheral sensing interfaces, through which data collected by sensors are sent to CPU module for data analysis and processing, and then sent out through external communication interface according to network transmission protocol. The advantage of feature-level fusion is that it achieves information optimization by processing the original data of each sensor and reduces the pressure of real-time processing. Feature level fusion is the most widely used fusion method in real-time systems. Under certain principles, the processing data are processed, analyzed, synthesized and used to obtain a unified and true interpretation of the observed quantity, and then support the decision-making process. The resulting data from this multiple sensor is made more dense than the amount of information it has in its various components. At the same time, because the feature information extracted by the system is closely related to the result of the final decision analysis, the data information collected by the extended extension network and packaged by the underlying protocol, including the data of the environmental data sensor and the image information collected by the image sensor. In the process of receiving and transmitting, the security of the received and transmitted data and the validity of the protocol encapsulation must be guaranteed.

The process of obtaining multi-source information by utilizing multiple sensors or other information acquisition devices, and synthetically processing multi-source information to obtain more accurate and reliable prediction results. When upper layer data is transmitted downwards, the data analysis module converts the request data conversion module into a data format that can be understood by the protocol adaptation layer and applied by the underlying sensing extension device. The conversion rules depend on the specific underlying communication protocol. In order to ensure that the data collected by the sensors participating in data fusion are from the same tested object, the unsafe data are analyzed and extracted, which lays a good foundation for subsequent decision-making analysis, processing and accident warning. Furthermore, the results of all sensor decisions in the system monitoring the same object are fused to obtain the final result. The data may be heterogeneous or may be from different

platforms for detecting different physical quantities. By observing the data of these sensors, the observation data may be combined in time or space by using time series under a certain criterion and strategy, and finally To obtain a unified interpretation of the observations. At the same time, knowledge acquisition and association reasoning can be automatically performed, and uncertain and complex data can be integrated into learning and reasoning into data that the system can process.

3. Design of Multi-Protocol Integration in Internet of Things

3.1 General process of multi-sensor data fusion

The module effectively links into the network, and accurately receives and sends data to the central data center, so as to verify the success of information exchange between sensor and data storage layer in wireless network layer. The trust function is defined as an exponential function. The nature of the exponential function determines that it can realize the range feature of membership function 0 ~ 1 in the fuzzy theory. According to the data information of different tested objects collected by sensor nodes, these data information are pre-processed separately. In order to avoid the inaccuracy of system detection caused by small values being masked by large values, it is necessary to normalize these data. If they are the same, they are equivalent examples. The multi-sensor data fusion parameters are shown in Table 1. Continue to compare the acquisition time. If the acquisition time is the same, you need to perform data fusion according to the fusion rule. If the acquisition time is different, the data with the earlier acquisition time is obsolete and redundant data. Its goal is to generate a report of the information as a confidence function based on the trust function. In the update state, since the sensor has a certain degree of error, it may be necessary to update the observation data of the sensor before reasoning and synthesis.

TABLE 1 MULTI-SENSOR DATA FUSION PARAMETERS

	Transformation	Distinguish
Feature extraction	3.39	2.81
Data fusion	2.68	2.50
Decision output	4.15	3.17

3.2 Sensor data redundancy and accuracy

System data caching and batch writing process. The database caching and writing module adapts different database tables in a generic way, which is usually called by the processor class. To call it, it needs to rewrite its functions. Fusion processing of multi-source information is completed in the information fusion center. This structure is mostly used in multi-sensor fusion systems which need long-distance information transmission. It has low requirements for broadband and good stability, which greatly reduces the computational load of the fusion center. When using production rules for information fusion, two or more rules of production discovery are fused according to certain criteria.Due to the inherent nature of this method, when the number of sensors changes, it is sometimes necessary to modify the rules that are added to the sensor. Only when the value detected by any sensor node monitoring the same object exceeds a preset threshold, the data collected by all sensor nodes monitoring the object will be transmitted to the intelligent gateway data fusion center for further data fusion processing. . The larger the value, the closer the data collected by the sensor is, that is, the more the other sensors trust the collected data, that is, the closer the data collected by the sensor is to the true value.

In the process of practical application, the data information collected by each sensor in the system provides a proposition for the system and establishes a corresponding mass distribution function. That is to say, the data information collected by each sensor in the multi-sensor detection system is equivalent to the evidence body in the evidence theory. When a suitable parser is found, the context gets its reference, which facilitates direct calls to the parser from later data. The unauthenticated device will be transformed into an authentication information, mainly to obtain its serial number, and then trigger an authentication device event. More detailed perception of situation at multiple levels increases the accuracy of situation perception, enhances the decision-making ability of the system, reduces the time of recognition and detection of target or target environment, and improves the detection efficiency of the system. The probabilistic density function is used to represent the source information, and the fusion information is optimized to combine the sensor information according to the probabilistic relationship, and the

uncertainty of measurement is expressed by conditional probability. The sensor information is combined and utilized according to the probability function. It obtains the posterior joint probability function by the correlation probability of each individual sensor, and finally obtains the fusion value by minimizing the probability function likelihood function. The global ontology describes the conceptual set of sensors. The local ontology describes the concepts and their specific contents in each sensor database. There is a mapping relationship between the concepts in the local ontology and the corresponding concepts in the global ontology.

4. CONCLUSIONS

In this paper, the intelligent fusion method of multi-sensor data in the Internet of Things is studied. The aggregation node of the sensing node completes a fusion processing of data information of all the sensing nodes of the same object under test. The decision result of fusion processing is used to judge whether there is any abnormal occurrence. The manageability of the Internet of Things gateway is to control and manage the underlying perceptual extension devices in a unified way. When transmitting data up, the heterogeneity of underlying protocols is shielded and the data format management is unified. Data fusion lays the foundation for automatic analysis and processing of multi-sensor data. Follow-up research can conclude reasoning rules and infer the fused sensor data. Form a deeper data fusion theory and algorithm; data fusion will support heterogeneous, multi-platform data; raw data through data-level fusion and feature-level fusion, acquire various attribute features of the target, and then fuse the acquired attribute feature data according to certain information fusion rules to get the final decision results. Establish data fusion methods for specific application needs. Reflecting different types of information of the target, with certain fault tolerance, reduced dependence on sensors, and high flexibility. Cache data, once again bulk copy to the database, greatly reducing the performance of database writes, so that the server reaches the fastest data write speed.

REFERENCES

[1] Si L, Wang Z, Liu X, et al. Multi-Sensor Data Fusion Identification for Shearer Cutting Conditions Based on Parallel Quasi-Newton Neural Networks and the Dempster-Shafer Theory. Sensors, 2015, 15(11):28772-28795.

[2] André, Cyrille, Hégarat-Mascle, Sylvie Le, Reynaud R.Evidential framework for data fusion in a multi-sensor surveillance system. Engineering Applications of Artificial Intelligence, 2015, 43:166-180.

[3] Safizadeh M S, Latifi S K.Using multi-sensor data fusion for vibration fault diagnosis of rolling element bearings by accelerometer and load cell. Information Fusion, 2014, 18:1-8.

[4] Luo R C, Lai C C.Multisensor Fusion-Based Concurrent Environment Mapping and Moving Object Detection for Intelligent Service Robotics. IEEE Transactions on Industrial Electronics, 2014, 61(8):4043-4051.

[5] Chavez-Garcia R O, Aycard O.Multiple Sensor Fusion and Classification for Moving Object Detection and Tracking. IEEE Transactions on Intelligent Transportation Systems, 2015, 17(2):1-10.

[6] Gravina R, Alinia P, Ghasemzadeh H, et al. Multi-Sensor Fusion in Body Sensor Networks: State-of-the-art and research challenges. Information Fusion, 2017, 35:68-80.

[7] Jing Q , Vasilakos A V , Wan J , et al. Security of the Internet of Things: perspectives and challenges. Wireless Networks, 2014, 20(8):2481-2501.

[8] Braca P, Goldhahn R, Ferri G, et al. Distributed Information Fusion in Multistatic Sensor Networks for Underwater Surveillance. IEEE Sensors Journal, 2015:1-1.