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Research Article

Perceptual Feedback Mechanism Sensor Technology in e-Commerce IoT Application Research

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With the development of sensor technology and the Internet of Things (IoT) technology, the trend of miniaturization of sensors has prompted the inclusion of more sensors in IoT, and the perceptual feedback mechanism among these sensors has become particularly important, thus promoting the development of multiple sensor data fusion technologies. This paper deeply analyzes and summarizes the characteristics of sensory data and the new problems faced by the processing of sensory data under the new trend of IoT, deeply studies the acquisition, storage, and query of sensory data from the sensors of IoT in e-commerce, and proposes a ubiquitous storage method for massive sensory data by combining the sensory feedback mechanism of sensors, which makes full use of the storage resources of IoT storage network elements and maximally meets the massive. In this paper, we propose a ubiquitous storage method for massive sensing data, which makes full use of the storage resources of IoT storage network elements to maximize the storage requirements of massive sensing data and achieve load-balanced data storage. In this paper, starting from the overall development of IoT in recent years, the weak link of intelligent information processing is reinforced based on the sensory feedback mechanism of sensor technology.

1. Introduction

IoT has penetrated every aspect of people's lives and has been widely used in agriculture, transportation, industry, marine, military, and other fields. IoT technology has indeed brought a lot of convenience to people's production and life. In the age of intelligence, people's demand for the perception of things is increasing. In terms of functional division, the IoT system can be divided into the application layer, network layer, and perception layer from top to bottom. The perception layer is the core of IoT, which is the key part of information collection. The sensing layer is the most basic in the three-layer functional structure of IoT, and its function is to obtain environmental information through the sensing network. The sensing layer is the core of IoT and is the key part of information acquisition. The sensing layer is generally the world of sensors, which is composed of various sensors or sensor networks together with controllers, such as temperature sensors that can sense the temperature, sensors that can test the concentration of CO_2 in the air, and sweeping sensors that can identify various QR code tags, or cameras, GPS, and other devices. The function of the sensing layer is similar to that of human's five senses, which can acquire natural signals and is mainly used to collect and process them to a certain extent to form information or to identify objects. The network layer is generally divided into wireless and wired communication methods and can be divided into LAN, WAN, etc., from the network scope, and leads to the more popular network management system and cloud computing platform, etc. It is similar to the equivalent of the human nerve center or blood vessels, which process the information collected from the perception layer, thus connecting the perception layer and the application layer. The application layer is the closest layer to the user, through which the IoT and the user are connected. It mainly uses the data and uses the data to achieve what the user needs and various applications. Nowadays, we see various applications, such as gravity sensor software in smartphones, GPS devices, and other software applications or hardware devices belonging to this layer.

The sensing layer forms a sensor network through a variety of sensors to collect and process signals in the form of a server for the IoT and an intermediary for user exchange. The core technologies of this layer include sensor technology, computer control technology, and RF technology. The core products involved include sensors, sensor networks, and controllers. Some common key technologies of the sensing layer are as follows: (1) sensor: the sensor is the main device to obtain information in the Internet of Things, it can capture natural signals through some of its characteristics and convert them into regular electrical signals or other signals so that people can use these signals to have a new understanding of natural signals. (2) Sensor network: sensor network is a sensor + controller + communication and constitutes a network system. Nodes through the communication network to form a sensor network, working together to sense and collect accurate information about the environment or objects. And now, the most common way of network communication using wireless methods to form a wireless sensor communication.

Perceptual feedback mechanism sensor in the face of the Internet of Things group intelligence perception of big data, the development of cloud computing for a large number of perceptual feedback sensor storage and computing processing provides a strong convenience and flexibility, the Internet of Things cloud platform to a large extent to reduce the burden of data owners on data storage and management. The new sensor data collection mode of IoT based on sensory feedback mechanism and the efficient data service mode of IoT based on cloud platform makes the participating users both the "producer" and "consumer" of data, giving full play to the potential value of big data. The potential value of big data. However, in each link of IoT group intelligence sensing feedback sensor data collection, aggregation, and service, its security and privacy issues have been the stumbling block that restricts the mature development of more IoT applications. In the new IoT architecture based on group wisdom sensing and cloud computing, the openness of the network, the diversity of participating users, and the curiosity and even maliciousness of the cloud platform make the IoT group wisdom sensing data security and privacy face more challenges, and the problems of participating users' privacy leakage, data forgery, tampering, and unreliability are more severe.

2. Related Work

In the new perception and service model of IoT based on perception feedback mechanism and cloud computing, the IoT group wisdom perception data goes through three different links of data collection, data aggregation, and data query service. The front-end group wisdom-aware data collection provides data sources for the intermediate data aggregation and back-end data processing, so solving the security and privacy problems in the group wisdom-aware data collection is the basis for ensuring the data reliability and service quality of subsequent application services. In the research of group intelligence-aware secure and reliable data collection, in addition to user privacy protection, data reliability, and incentive mechanism are the key factors affecting the quality and quantity of perceived data and are also key issues that need to be solved.

In recent years, compressed sensing-based feedback mechanism sensor data acquisition has attracted great attention from research scholars and has become a research hotspot in this field. The literature [1] is an early paper investigating the application of CS in perceptual feedback mechanism sensors, where the authors propose a distributed joint source-channel communication architecture for the efficient estimation of perceptual data. However, this literature does not address the case of multihop communication, where all sensor nodes transmit the sensory data to the sink node in synchronized, single-hop communication. For the case of multihop communication, the literature [2] introduces random access compressed sensing to the underwater sensing feedback mechanism sensor geography and long-term monitoring of the environment. RACS uses a random sensing, random access channel approach. Similar to this literature, for event detection of underwater sensory feedback mechanism sensors, the literature [3] uses a uniformly random sampling method and proposes a weighted basis tracking algorithm. The feasibility of the proposed method is verified by compressing the detection mechanism on the MicaZ sensor node. The literature [4] applies CS to sparse event detection. Since most of the measurement matrices in CS currently use random matrices and the selection of sensor nodes has certain randomness, the authors discuss the optimal selection of sensor nodes, introduce a deterministic selection mechanism of sensor nodes, and separate the event detection from the number of events through 2S-GMP, which reduces the computational burden and improves the performance. The literature [5] investigates the connection between sensory feedback mechanism sensor data transmission and CS, combining routing with CS. The literature [6] considered the problem of combining routing design with CS and pointed out that the sparse random measurements of sensory data with the shortest path approach are limited for compressed data collection. In energy-constrained wireless body sensor networks, the literature [7] introduced CS to the acquisition and compression of ECG data on a platform and quantitatively analyzed the real-time and energy efficiency of CS applied to ECG data acquisition and compression. In the literature [8], the energy consumption model of the sensor with sensory feedback mechanism is investigated and the energy efficiency of CS in compressed data acquisition is analyzed theoretically. For the problem of compressed aggregation of sensor data for the sensory feedback mechanism, the minimum spanning tree projection algorithm and the extended minimum spanning tree projection algorithm are proposed in the literature [9]. Each measurement selects the nodes of interest participating in CS based on a sparse random matrix and then transmits the random projection to the sink node through the aggregation tree structure to minimize the number of random projection transmissions and equalize the traffic burden of the whole network. Distributed compressed data acquisition is a variant of compressed data acquisition. The study of distributed compressed data acquisition has also become a hot topic due to the temporal and spatial correlation of sensor data of the perceptual feedback mechanism [10]. For the problem of data acquisition in distributed perceptual feedback mechanism sensors, the literature [11] uses a tree topology to transmit data and uses wavelet bases to compress the perceptual data. The literature [12] analyzes the compressed acquisition of multidimensional signals, uses principal component analysis and CS to jointly reconstruct the multidimensional signals, and introduces the idea of feedback in control systems to make the reconstruction error adaptive to the changes in the signals. The literature [13] also describes compression-aware reconstruction algorithms as well as matrix filling techniques. In the literature [14], the study of compressive sensing of sensors with sensory feedback mechanisms based on spatial correlation was carried out and a distributed compressive sensing based on wavelet transform was proposed. For large-scale sensory feedback mechanism sensors, the literature [15] compares traditional data acquisition methods with compressed data acquisition methods in chain topologies and presents a complete compressed data acquisition scheme for the first time, pointing out that compressed data acquisition can reduce the energy consumption of network communication and can equalize the energy consumption among nodes.

3. Application of Sensor Technology Based on Sensory Feedback Mechanism in e-Commerce IoT

3.1. Principles of Sensor Technology Based on a Sensory Feedback Mechanism. The ranking algorithms for sensors with sensory feedback mechanisms present in IoT are CASSARAM in which the user selects the sensor attributes and inputs the weights of each sensor attribute to ensure that their sum is 1, and then, the Euclidean distance algorithm is used for the ranking calculation, which is ranked according to the distance; the algorithm is simple but loses some accuracy; in literature [16], AHP is used for the weighting of relatively several sensor attributes for normalized calculation of weighted scores for dependencies among sensor nodes, etc., in the underlying IoT and ranking according to the size of the scores; literature [17] proposed a similarity comparison ranking algorithm to compare the similarity of the output data of a given sensor over some time with the user search output data for ranking. The literature [18] proposed a prediction using statistical data from the past period, and the search and prediction model helps to find the matching sensors retrieved with the minimum number of sensor data.

In the feedback link, the traditional feedback algorithms are mostly based on the user's drag and drop, click, satisfaction rating, and dependency of the web text keywords for the web environment to reorder the web text. The feedback algorithms include the BP network feedback based on the self-learning and self-grouping characteristics of neural networks, the PageRank algorithm that adds the feedback of web page release time, the support vector machine-based feedback algorithm that maximizes the difference between the average vector of relevant results and the average vector of nonrelevant combinations, and the Rocchio algorithm that calculates the optimal search query vector that has the strongest similarity to the set of relevant documents and the set of nonrelevant documents and the weakest similarity to the set of unrelated documents. The above IoT search sorting feedback algorithms have their focus, and the multiattribute sorting algorithm based on feedback weight proposed in this paper innovatively introduces context-aware multidimensional attributes based on the traditional sensor sorting multidimensional attributes and quantifies the multidimensional attributes such as directional angle, distance, and trajectory overlap between the element to be sorted and the user in this motion context under the dynamic context where the user has motion direction and motion trajectory, and under the same conditions, the elements near the user's upcoming direction in the motion context are considered to be ranked higher than the elements that have already passed by, to better understand the user's search scenario, and the ranking results are more consistent with the user's search intention in the context of a specific motion direction [19]. In the same way, this paper introduces a dynamic weight model based on user feedback, which has a self-learning function, analyzes feedback results comprehensively, dynamically adjusts the multiattribute weights of user groups according to user feedback, classifies users, reduces algorithm complexity, ensures system computation speed, has wide applicability, is more consistent with context-aware search scenarios, and returns to users ranking results that match current contextual information.

In this paper, context-aware attributes can be divided into user context-aware attributes and sensor context-aware attributes. The sources of user context-aware information are mainly collected by sensors such as sensors and wearable devices on the user's mobile side, and the dynamic context-attribute information obtained by the user's mobile side is motion trajectory vectors, GPS location, etc. The contents of the formulas involved in the structural transformation are as follows.

(1) The motion track is determined by the $\vec{u} = (u_s, u_e)$ display input vector, where u_s is the user input starting position and u_e is the user input destination position; if there is no explicit input vector, then take the real-time direction information obtained by the mobile sensor $\vec{u} = \vec{u}_d$ as the motion direction of the current period, the user's current position GPS information including latitude, longitude and latitude variables, user acceleration, and user schedule, expressed as

$$\vec{u} = (u_1, u_2, u_3, u_4, \cdots, u_n), \tag{1}$$

where u_n indicates the user situational awareness information. Among them, GPS information generally needs to be transformed into distance attributes of two locations for the next step of computational processing, and the distance calculation refers to google map's latitude and longitude distance algorithm as follows:

$$\gamma = \sin^{-1} u \sqrt{\sin^2 x + \cos\ (\text{lattitude 1}) \times \cos\ (\text{lattitude2}) \times \sin y} + \kappa. \quad (2)$$

The quantitative comparison between motion trajectory vectors is mainly a cosine similarity algorithm, with higher similarity indicating that the element better matches the expectation of the user-set trajectory, and is ranked higher.

$$\eta = \begin{vmatrix} A \sin u \cos x & \cos \gamma \\ \sin \gamma & -\sin y \end{vmatrix}. \quad (3)$$

(2) Sensor situational awareness information of IoT has several categories, and usually, there are different sets of situational awareness information under different search-demand scenarios, such as traffic condition index, weather, and distance. Here, we $\vec{r} = (r_1, r_2, \cdots, r_n)$ characterize the set of IoT sensor situational awareness information under the search conditions. After obtaining user search input and situational awareness information through attribute conversion, the system determines the situational awareness information to derive a specific search scenario and thus finds other sorted attribute information of this search category in the ontology model, expressed as

$$\vec{k} = (k_1, k_2, \cdots, k_n). \quad (4)$$

In practical application scenarios, often to get the optimal results will be a comprehensive consideration of the attributes of the ranking, to the maximum extent to enumerate all relevant factors, and the ranking calculation will be too many attribute variables, and the high correlation between variables, which brings a certain impact on the analysis and model building. In the case of too many reference attributes for ranking, this paper adopts the cluster analysis method to cluster the indicators with similar attributes into the same indicator, which reduces the computation and has no significant impact on the ranking results. Cluster analysis is a method of mathematical statistics to study "things are clustered together," which is an algorithm to aggregate a large set into several "clusters" according to specified distance indicators. Cluster analysis and R-type cluster analysis two categories, the calculation method of clustering can be divided into direct clustering method, the shortest distance clustering method, the farthest distance clustering method; this paper uses the farthest distance clustering method, simple and direct, using the farthest distance to measure the distance between the data as follows:

$$R^A(t) = \frac{\partial\left(\left(\left[\alpha_a{}^2(t)\right]^k \left[\beta_b{}^2(t)\right]^j\right) / \left(\sum_{m \neq a, n \neq b} \left[\alpha_m{}^2(t)\right]^k \left[\beta_n{}^2(t)\right]^j\right)\right)}{\partial t}. \quad (5)$$

The longest distance method is used for clustering. Define the distance of the 2 variables as

$$\kappa(t+n) = (1-\eta)\kappa(t) + \Delta\kappa_{ij}(t). \quad (6)$$

After clustering, the number of attribute parameters becomes smaller, and the final attribute information involved in sorting is divided into three parts, user context-aware attributes [20]. The user receives the sorting results returned by the server through the mobile terminal and performs feedback behaviors such as clicking and browsing, marking as interested or not interested, or performing scheduled activities on the sorted elements. The feedback module of the mobile terminal returns the user's feedback behaviors to the server, and the system analyzes and calculates the feedback results, and through the calculation results, reasoning about the user's preference for each attribute, to further adjust the corresponding attributes. The system will analyze and calculate the feedback results, reason the user's preference for each attribute through the calculation results, and further adjust the weight of the corresponding attribute to gradually reach a stable weight range under the current context classification, to achieve the optimal sorting results and most importantly meet the user's search expectations.

Figure 1 shows the comparison of the standard Gaussian function, hyperbolic tangent function, and approximate hyperbolic tangent function for $\delta = 0.1$. As can be seen from Figure 1, compared with the standard Gaussian function and hyperbolic tangent function, the approximate hyperbolic tangent function can better approximate the L_0 parametrization with smoothness and has better "steepness" in the interval of [-0.2,0.2]. That is, it converges faster and with higher accuracy in the estimation process. In the approximation of the L_0 parametrization by the hyperbolic tangent function, the L_0 parametrization can be approximated as

$$L_0 = \lim_{x \longrightarrow 0} g_x(L). \quad (7)$$

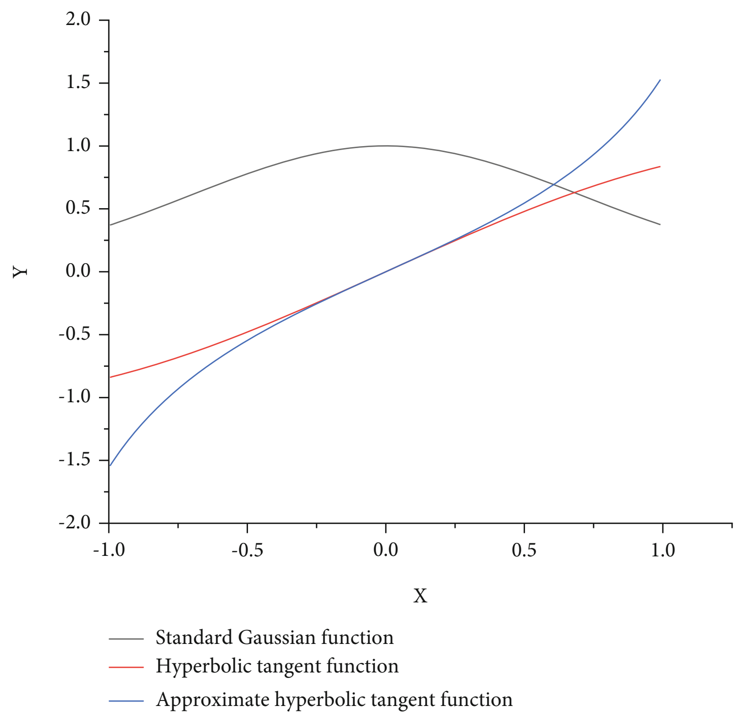

Figure 1: Comparison of standard Gaussian function, hyperbolic tangent function, and approximate hyperbolic tangent function.

Through the multiobjective optimization algorithm based on the approximate hyperbolic tangent function, the perceptual feedback model can be solved globally optimally to avoid the model calculation results in the local optimum state, which affects the accuracy of the model. The traditional feedback algorithm usually uses the most rapid descent method to get the descent direction; the most rapid descent method starts with a large step size and requires a low initial point, but due to the effect of the sawtooth phenomenon, the most rapid descent method can only approach the proximity region of the optimal solution relatively quickly, but the convergence speed is slow from the global perspective [21], that is, the descent direction of the most rapid descent method is not the fastest direction, and its descent direction is shown in Figure 2, so it is generally used as the opening of the optimization process.

3.2. Application of Sensors Based on Sensory Feedback Mechanism in e-Commerce IoT. To achieve the definition of the Internet of Things as e-commerce requires the connection of sensory feedback sensing devices with the Internet to achieve intelligent identification and management, it is indispensable to make items "speak, release information" sensor support; the study of the Internet of Things in the key technology sensor network is very important, the following to study the sensor network. The following is the general application model of a sensor in IoT (sensor or sensor network + controller + communication). The sensing layer in IoT is generally played by sensors or sensor networks, who are responsible for collecting and processing data; some applications are supported by a single sensor, and some require a large number of sensors, which requires the formation of a sensor network [22–24]. Through IoT, the connectivity between things is generally established using the model of sensor + controller + communication. The sensor is generally responsible for collecting signals, communication using wired or wireless methods, and the controller is mainly working for the signal collection and the whole control of the processing process, which can be realized by software and hardware. The IoT thematic units are shown in Figure 3.

When a new user first enters the IoT network for search, the user belongs to an unknown user group and the user's attribute weight preference is unknown; at this time, through the user's context-aware information input and the user's display condition input, the system will go to the hierarchical system as shown in Figure 4, the first index to the geographic area hierarchy, will link to the search type hierarchy under this hierarchy, and has several user groups under the type hierarchy, which will contain the composition distribution of the group with the highest number of users used as the initial search ranking weight for new users.

The sensor data reporting based on the sensory feedback mechanism is based on the successful registration of the lower unit. First through the session.getAttribute() method to obtain the lower registration, stored in the current session of the device and sensor information. First, determine whether the message packet conforms to the sending specification if the protocol header and data header of the message packet is not consistent with the results of the communication protocol settings directly through the session. Write() to tell the lower unit to resend the data. If the message packet meets the message specification, it enters the data processing module and gets the different communication protocols required for data processing according to

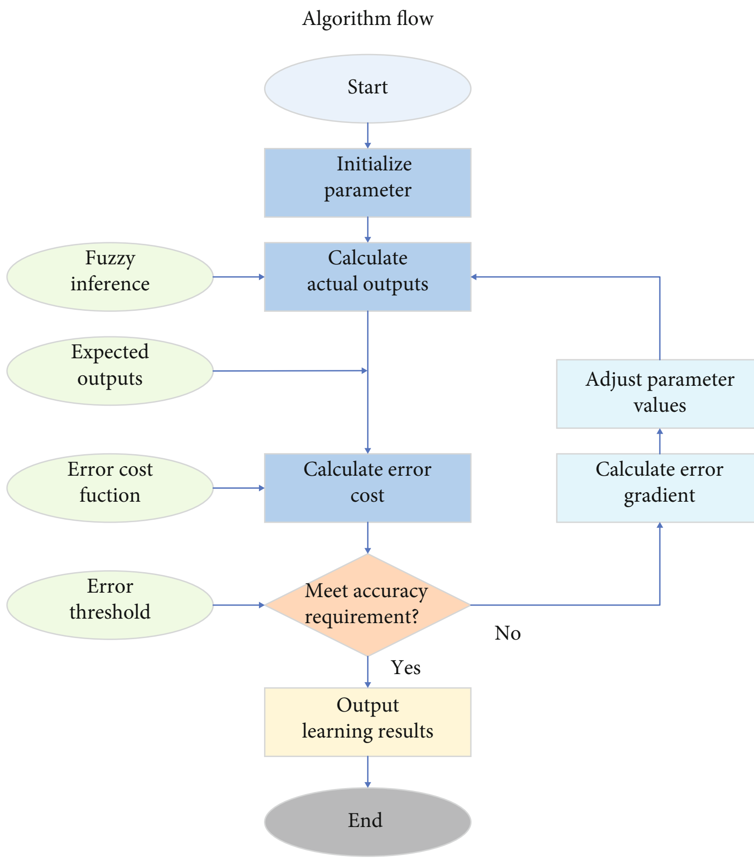

Figure 2: Fastest descent method descent flow.

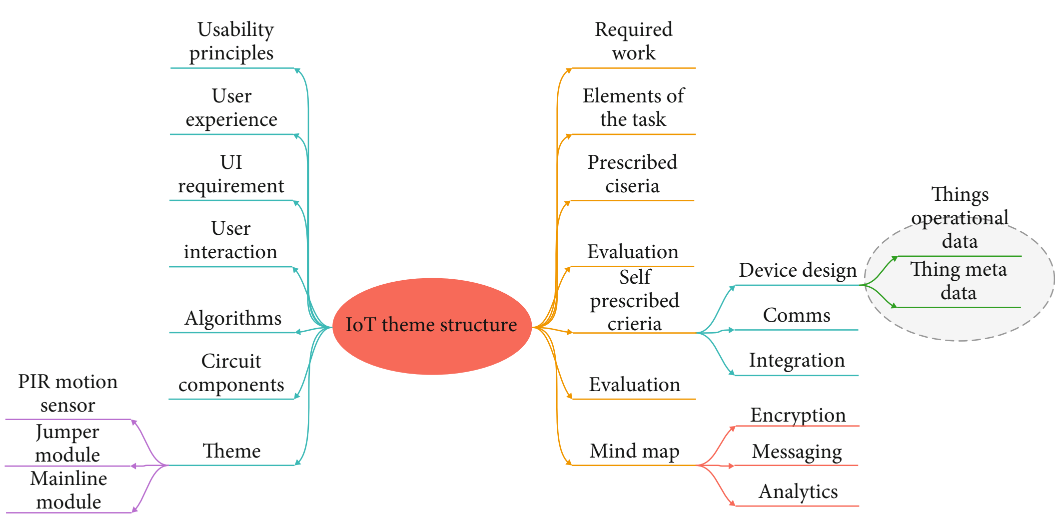

Figure 3: IoT theme structure diagram.

the path names of XML communication protocols. The data processing is done through the getResolve() method in the ManageXml class. The hexadecimal data obtained after the data parsing is completed and is converted into actual data by the DataConvert.HexStringToFloatString() method. In this method, the default data area is read at every 2 bytes, and the first digit of the data converted to binary data indicates the positive and negative data and is retained to two decimal places. Different types of sensor data at the device terminal are stored at different addresses in the registers, and the user sets the specific address assignment when customizing the communication protocol. When users add device information and sensor information through the web platform, the address of the register corresponding to the sensor is associated with it and stored in the database. When the sensor data is reported and parsed by the custom

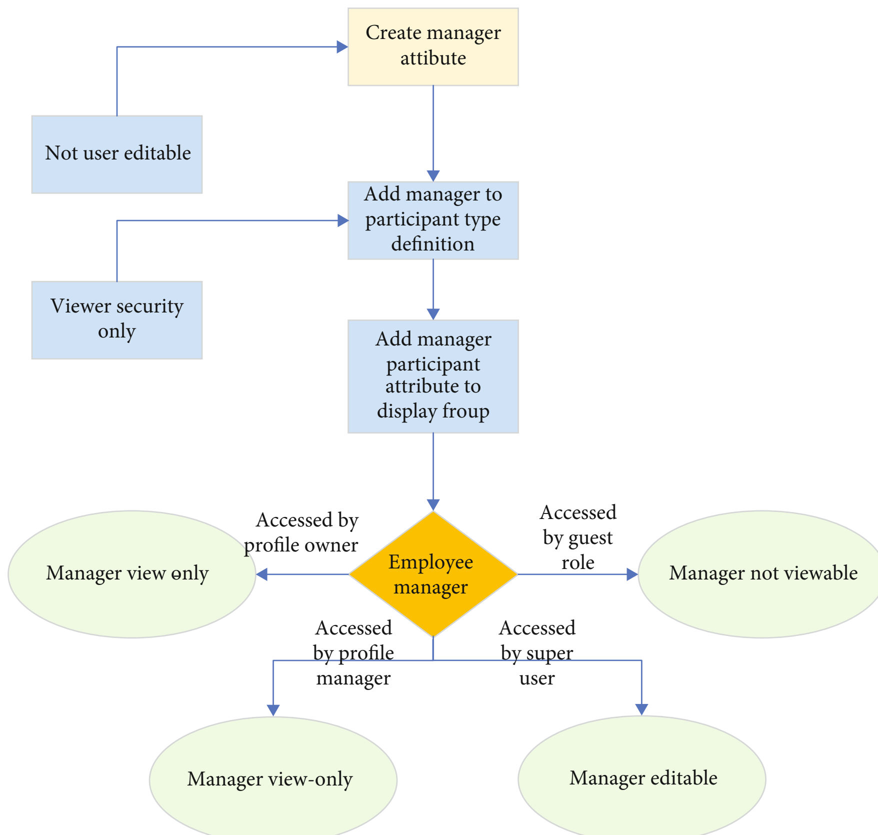

Figure 4: User hierarchy chart.

communication protocol, the corresponding sensor information will be obtained based on the register address information in the data area to reduce the dimensionless sensor data to physical data with units. Finally, through the save() method in MangerHelper, the data is saved to the database through the data service class to achieve persistent operation. The visualization of the real-time data on the website is performed by the Datagrid() method, just like the visualization methods of other modules of the web management platform.

4. Experimental Verification and Conclusion

4.1. Experimental Validation. Assuming that different kinds of sensors with different characteristics, including air quality sensors, temperature and humidity sensors, personal cell phones, sensors for detecting traffic devices, sensors for detecting road conditions, sensors for wearable devices, and sensor devices for research institutions, are connected to the sensor network, and the cost of services provided by sensors with different characteristics is different, it is important to search for sensors that meet the needs of users in the massive sensor network and to consider maximizing the efficiency of the IoT. To search for the sensors that meet the user's needs in the vast sensor network and consider maximizing the efficiency of IoT, it is of great significance to accurately rank the sensors to apply the sensor information to various scenarios. This chapter focuses on the simulation experiments of a multiattribute ranking algorithm based on feedback weights. The sorting algorithm proposed in this paper can solve the multiattribute sorting problem in dynamic context, which mainly refers to the multiattribute sorting problem in the context where the user has motion trajectory and motion direction, for example, using the IoT rental car class problem, when the user carries out electric car rental and charging selection, there are several options in the entity world, and the user considers several comprehensive factors such as distance, electric car power, motion trajectory, and time to derive sorting results. For example, continuous search problem, the user needs to carry out the needs of activity A and activity B; then, he has to search for a place that can meet the needs of activity A first and the needs of activity B in another time period, while considering the direction of movement or intention; this context requires consideration of multiple attribute sorting, and then, for example, the route planning problem, the user determines the direction of the route, there are a number of to be selected routes, it is necessary to synthesize contextual factors and sensor attribute factors to derive a comprehensive ranking result, etc. The proposed ranking algorithm in this paper takes into account the attribute information in this type of context comprehensively and intelligently and fully investigates and calculates the user's context and search intention. Groups to provide the optimal ranking results. By searching multidimensional attribute data in a specific context, the data is processed, modified, and matched in the database and then clustered and semantically labeled to enable subsequent application and postprocessing of the data.

The ranking strategy studied in this paper can solve multiattribute ranking problems in dynamic contexts with motion direction, motion intention, or motion trajectory, such as car rental type problems, route planning problems, and continuous search problems. In this simulation, due to the limited data source, the search context considered here is the search and sorting of charging piles in the car rental problem. In this paper, the simulation design scenario is that the user needs to charge the vehicle after renting an electric vehicle, and the sorting calculation is performed on the element data represented by the charging stake, and the multiattribute sorting calculation is performed based on the multidimensional sensor attributes and contextual attributes, and the attribute weights and attribute values are calculated, and finally, the sorting is performed according to the sorting score. In this search context, the destination to be visited by the rental car, the rental period, and the number of riders are set in the system, while the system obtains implicit contextual attribute information such as the user's current location, schedule, and acceleration. The system obtains the corresponding sensor context set information and sensor attribute information from the database according to the user context attribute set, including the vehicle's power attribute, battery capacity attribute, charging pile information in the rental network, and traffic condition index and weather. The attribute information is to be considered as more than 20-dimensional attributes.

When the sensor data communication system receives a frame of data, it judges the function of the message according to the main function code of the communication protocol, and if it is registered data or active query request, it waits for the message to be processed so that the processing result can be returned immediately after the message is processed. If it is normally reported data, it immediately answers the received data and informs the lower computer that it can continue to send data, while opening a new thread to finish the data persistence saving work asynchronously, without affecting the normal operation of the communication thread. The server can keep receiving messages and opening new threads until it reaches the maximum number of threads.

In practical applications, there are often interference sources such as buildings in the field of WSN-based positioning monitoring, and the unknown node cannot communicate normally with the beacon node, affecting the positioning accuracy and positioning reliability of the unknown node. Mobile beacons need to identify and inform the nonvisual range interference caused by interference sources such as buildings, i.e., mobile beacons need to identify the interference sources and their ranges normally during the moving process and successfully travel around the obstacles to ensure that the unknown nodes near the obstacles can obtain sufficient positioning calculation information on the one hand and inform the unknown nodes near the obstacles to correctly identify their neighboring beacons, on the other hand, to avoid increasing the positioning deviation due to incorporating the wrong beacon information into the computation, which increases the bias of localization. Many algorithms are now available to analyze the interference of NLOS in multiple directions, which can be divided into two main types, namely, comparing the models of line-of-sight environment LOS and non-line-of-sight environment NLOS, reconstructing the line-of-sight propagation model and weakening the influence of non-line-of-sight environment on localization by using filtered weighted least squares, residual weighting, hidden Markov model, and cooperative localization.

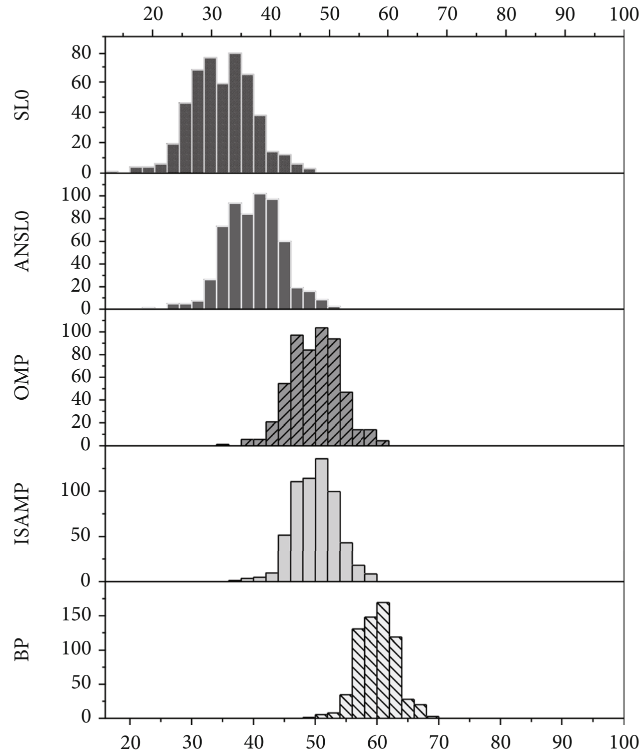

Figure 5: The gap of positioning effect between different algorithms.

4.2. Experimental Conclusions. Set $K = 7$, $M = 45$, and $\mathrm{SNR} = 25\,\mathrm{dB}$, and simulate and compare the localization effect using six algorithms BP, OMP, SL0, ANSL0, AHSL0, and ISAMP, respectively; the program was run 200 times, and the average value was taken, and the localization results are shown in Figure 5. From Figure 5, it can be seen that SL0, ANSL0, AHSL0, BP, and ISAMP algorithms have high localization accuracy and better localization effect, while OMP has a larger localization deviation and requires known sparsity and poor localization performance.

The performance of the five algorithms is compared and analyzed under different SNRs, and the number of sensors M and the number of targets K meet the requirement of $_{K\log 2}(N/K) = 66$. At $\mathrm{SNR} = 6\,\mathrm{dB}$, the performance of the AHSL0 algorithm improves 27% compared with the SL0 algorithm, 9% compared with ANSL0, 59% compared with the OMP algorithm, and 18% compared with the BP algorithm, which shows that AHSL0 has good antinoise

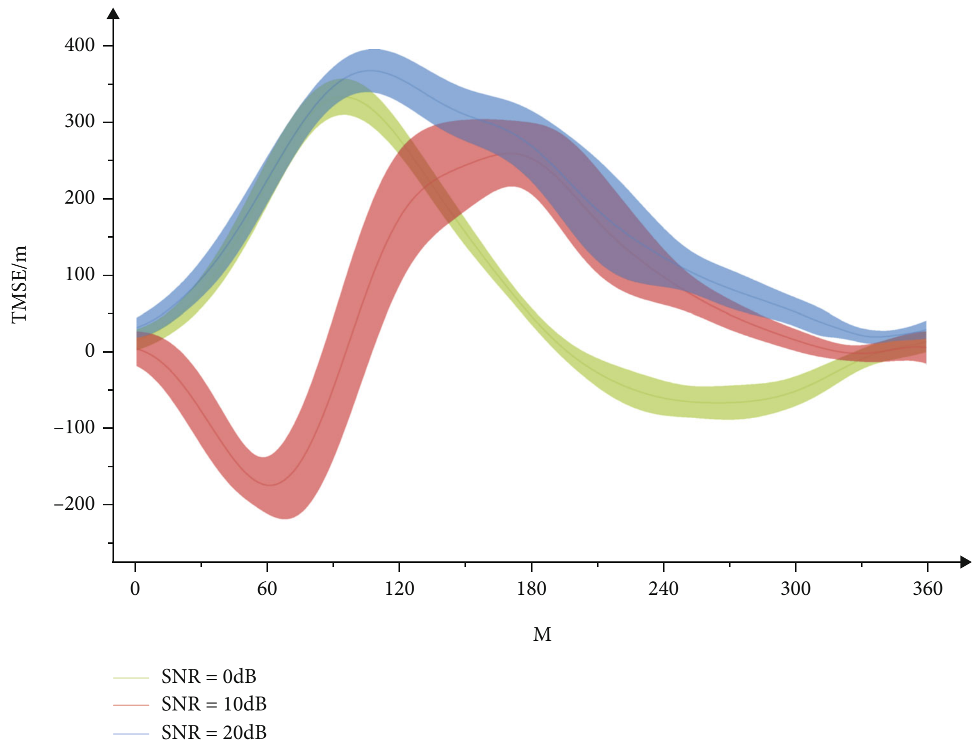

Figure 6: Performance comparison of five algorithms.

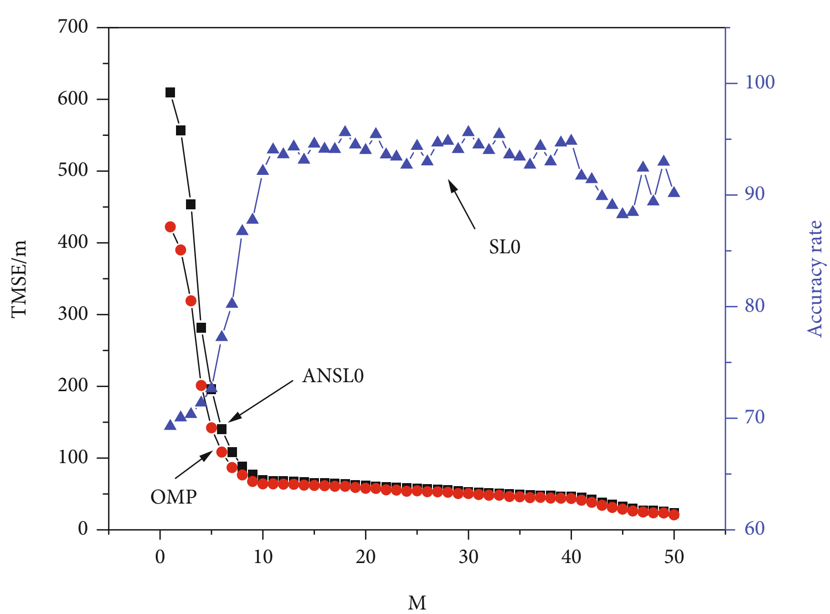

Figure 7: Comparison of positioning errors for different M cases.

capability and good positioning accuracy. AHSL0 has good noise immunity and positioning accuracy. The results in Figure 6 show that the average localization error of the AHSL0 algorithm varies less at SNR ≥ 10 dB, and the average localization error is less than 1 m at $M \geq 60$, which further shows its insensitivity to noise.

The average running time and average localization error TMSE of the five algorithms with $K = 14$, $M = 70$, and SNR = 10 dB, and the same number of measurements, the improved algorithms have some improvement in operation time and accuracy, and the AHSL0 algorithm still has the time advantage compared with the OMP algorithm, and the localization error is much lower than the OMP algorithm, which effectively improves the localization compared with the BP algorithm, the computational complexity of the AHSL0 algorithm is reduced, the positioning time is

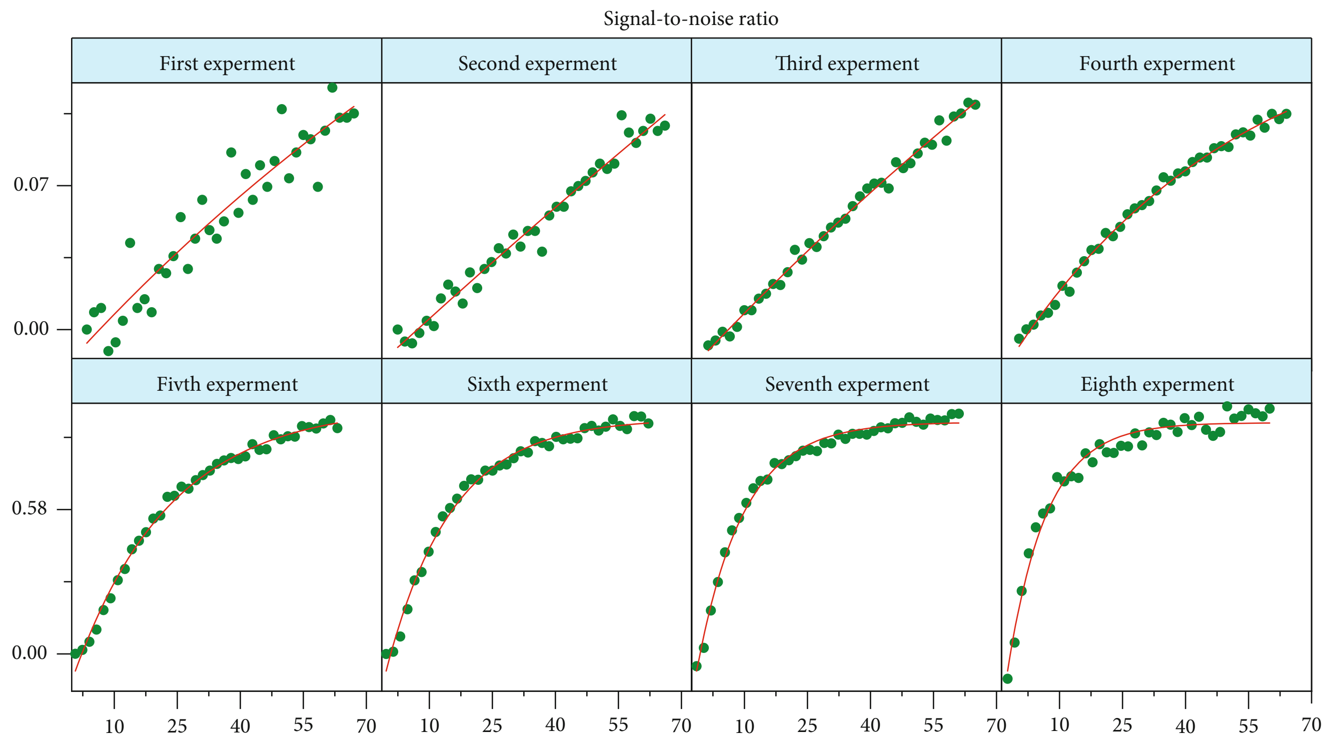

Figure 8: Variation of signal-to-noise ratio between reconstructed signal and original signal with the number of iterations.

shortened by 1-2 orders of magnitude, and the real-time positioning performance is better. Compared with SL0 and ANSL0 algorithms, AHSL0 is more accurate and converges faster, which shows that the hybrid optimization algorithm with approximate hyperbolic tangent function effectively solves the "sawtooth" phenomenon of the fastest descent method, accelerates the convergence speed, and improves the convergence accuracy. Figure 7 shows the effect of the number of sensors on the average positioning error for a signal-to-noise ratio of 10 dB and a positioning target. It can be seen from Figure 7 that the average positioning error decreases with the increase of the number of sensors, and the average positioning error is less than 1 m when $M > 60$, and the positioning result is close to the real position. And when $M \geq 80$ (between 4 K and 6 K), the average positioning error is less than 0.5 m, and the positioning result is more accurate.

For $M = 60$ and SNR = 10 dB, the simulation analyzes the effect of the number of targets on the localization results. Figure 8 shows the average localization error curve with the number of targets for the number of targets from 10 to 20. The results show that the localization error increases as the number of targets increases, the OMP algorithm has a higher error when the number of targets is large, and the localization performance is poor, while the SL0, ANSL0, and AHSL0 algorithms are much better than the OMP algorithm. Compared with the BP algorithm, the AHSL0 algorithm has better localization performance when the number of targets is $K \geq 12$. It can be seen that the AHSL0 localization algorithm is more advantageous when the number of targets is large. As shown in Figure 8, the probability of successful localization decreases with the increase of the number of targets, and the AHSL0 algorithm has a higher probability of successful localization than the ISAMP algorithm in the case of a low signal-to-noise ratio. The average running time of the ISAMP algorithm is 0.0114 s, which is significantly longer than that of the AHSL0 algorithm.

The design and implementation of an e-commerce IoT strategy based on sensor technology with sensory feedback mechanism can be divided into three major parts, namely, mobile, server, and database, from the engineering implementation perspective, and three major functions, namely, user information management, sensor information management, and event management, from the functional module classification. Combining these two classification perspectives, the engineering design and implementation of the IoT search and sorting platform is presented in detail, and the search and sorting engineering in a specific context is demonstrated in the form of user-friendly interface screenshots, thus verifying the usability of this dynamic feedback multiattribute sorting strategy.

5. Conclusion

Compared with traditional Internet search services, the data heterogeneity, massive data characteristics, spatiotemporal characteristics, and dynamic nature of IoT determine that IoT search services face more enormous challenges. The ranking problem in IoT search is a critical and extremely difficult problem to solve. In this paper, we study the sensing technology based on the perceptual feedback mechanism and perform some optimization of the perceptual feedback results to perform the global optimal ranking, which improves the problem of errors in the ranking results. By analyzing the user's search requirements in specific contexts, a complete set of algorithms for the perceptual feedback mechanism is formed, which is sufficient to deal with various complex situations encountered in the application of IoT.

In this paper, through the study of various aspects of multiattribute sorting algorithms with feedback weights in IoT search, a distributed two-tier IoT search service architecture is proposed, fast screening and accurate sorting links in multiattribute sorting strategies are proposed, and the weights of the attributes in the sorting are self-learning and adjusted with feedback, mainly from the following aspects.

Firstly, the data characteristics of IoT are studied, the service architecture of the existing IoT search engine is investigated, and the distributed two-tier search service architecture is proposed and analyzed with the characteristics of this sorting strategy. The input of this search ranking is also given, which is including user explicit input and implicit contextual information input, and the ontology model of IoT-aware data under this ranking strategy is briefly introduced.

Secondly, to solve the problem of perceptual feedback mechanism in the case of users with specific motion trajectory and direction, the context-aware multidimensional attributes are innovatively introduced, including several dimensions of user context-aware attributes and sensor context-aware attributes, to better determine the current search ranking context and search intention of users, and at the same time, combined with the dynamic nature of the search ranking context, the feedback-based dynamic weight model is proposed. It solves the problem that traditional IoT search must be input by the user to input attribute weights and makes the ranking model self-adjusting and able to solve the ranking problem in different search ranking contexts.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

We declare that there is no conflict of interest.

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