

Research on Data Fusion and Analysis Based on Artificial Intelligence Algorithm in Sensor Networks

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Abstract: This paper discusses the data fusion and analysis technology based on artificial intelligence algorithm in sensor networks. Firstly, the basic concept, composition and structure of sensor network are summarized, and its characteristics and challenges are analyzed. Then, the basic principle of data fusion technology and its application in sensor networks are introduced, and the basic concept, classification and application of artificial intelligence algorithm in data fusion are described in detail. On this basis, this paper constructs a data fusion framework based on artificial intelligence, and proposes a new data fusion method combining deep learning and machine learning algorithm. This method can effectively improve the accuracy and reliability of sensor data and reduce data redundancy and noise interference. In addition, the thesis also conducts in-depth research on the application scenarios of data fusion and analysis in sensor networks, including Environmental monitoring, intelligent transportation, medical health and other fields. The effectiveness and practicability of the proposed method are verified by experiments and case studies. Experimental results show that the data fusion technology based on artificial intelligence algorithm can significantly improve the data processing ability and analysis accuracy of sensor networks, and provide strong support for related applications. Finally, this paper summarizes the main conclusions of the study, and points out the shortcomings of current research and future prospects. In the future, the data fusion method based on artificial intelligence will be further optimized and improved, and its application in more fields will be expanded, which will provide more powerful support for the development and application of sensor network technology.

Keywords: Sensor networks, Artificial intelligence algorithms, Data fusion, Data analysis.

1. Introduction

With the rapid development of information technology, sensor networks have become an indispensable part of modern society, widely used in Environmental monitoring, intelligent transportation, health care and other fields. Sensor networks collect and process a variety of data through a large number of sensor nodes, providing important information support for various fields. However, due to the large number of sensor nodes, the variety of data and the existence of noise and redundancy, how to effectively carry out data fusion and analysis has become an urgent problem to be solved. As an effective data processing method, data fusion technology can integrate and optimize data from different sensor nodes, and improve the accuracy and reliability of data. The continuous development of artificial intelligence algorithm provides a more powerful and flexible tool for data fusion. By using the algorithms of deep learning and machine learning, we can mine and analyze the sensor data more deeply, and find the potential rules and patterns in the data. Therefore, this paper aims to discuss the technology of data fusion and analysis based on artificial intelligence algorithm in sensor networks. We will first introduce the basic concepts and development of sensor networks and data fusion technology, and then elaborate the application and advantages of artificial intelligence algorithms in data fusion. Then, we will analyze the effect and challenge of data fusion method based on artificial intelligence in practical application. Finally, we will summarize the main research results, and look forward to the future research direction and application prospects^[1]. Through the in-depth study of data fusion and analysis technology based on artificial intelligence algorithm in sensor networks, we hope to provide useful reference for the research and application of related fields, promote the further

development of sensor network technology.

2. Overview of Sensor Networks

2.1. Basic concepts of sensor networks

Sensor network is a kind of computer network which is composed of many automatic devices distributed in space. These devices use sensors to collaboratively monitor physical or environmental conditions at different locations, such as temperature, sound, vibration, pressure, motion, or contaminants. The network was originally developed for military applications such as battlefield monitoring, but is now widely used in many civilian applications such as environmental and ecological monitoring, health monitoring, Home automation and traffic control. Specifically, a sensor network consists of a large number of tiny sensor nodes deployed in a specific region, which have wireless communication and computing capabilities. Through self-organization, these nodes form a distributed intelligent network system which can accomplish the assigned tasks independently according to the environment. The distance between nodes in sensor networks is usually very short, and multi-hop wireless communication is used to communicate among them. In addition, sensor networks are not limited to data collection and transmission, but also include the ability to process and analyze the collected data. This enables sensor networks to provide richer and more in-depth information to support a variety of application requirements. In a word, sensor network is a kind of highly integrated and intelligent network system, which realizes the real-time monitoring and perception of environment or object through cooperation, and provides powerful data support for various applications^[2].

2.2. The composition and structure of sensor networks

The composition and structure of sensor networks are relatively complex and diverse, but generally can be divided into several core components. First of all, the sensor node, which is the basic unit of the Sensor Network, is responsible for collecting environmental information and transforming it into digital signal for transmission^[3]. Each sensor node usually includes a sensor module, a processing module, a communication module and a power module. Sensing module: Used for sensing and measuring the physical quantities in the environment, such as temperature, humidity, pressure, light, and so on, and convert them into electrical signals. Then, the electrical signal of the sensor module is processed, including signal amplification, filtering, analog-to-digital conversion and other operations, while performing the necessary calculation and control tasks. The communication module is responsible for wireless communication with other sensor nodes or central nodes to achieve data transmission and exchange. Finally, there is the power module, which provides a steady supply of power to the sensor node, usually using battery-powered or energy-harvesting technology.

The topology of sensor network describes the connection mode and communication path between nodes. According to the different connection mode and communication protocol between nodes, sensor networks can be divided into several topologies, such as star structure, Mesh structure and tree structure. Star-shaped structure takes the center node as the core, and other sensor nodes communicate directly with the center node. The mesh structure is a complex mesh connection formed by multi-hop communication between nodes, which has better robustness and scalability. The tree structure is the node according to the level organization, forms the tree structure, is suitable for the classification management and the control application scene. The central node or sink node plays an important role in the sensor network, which is responsible for collecting data from each sensor node and possibly performing data preprocessing, storage and forwarding. The central node usually has strong processing ability and communication ability, and can connect with the external network (such as Internet) to realize the remote transmission and sharing of data. Effective Communication Protocol and network management strategy are indispensable to the normal operation of sensor networks. The communication protocol defines the format, timing and mode of data transmission between nodes to ensure reliable data transmission. Network management involves the configuration, monitoring and maintenance of sensor nodes to ensure the stability and security of the network. Sensor Network is a distributed network system which consists of a large number of sensor nodes connected by wireless communication. Its composition and structure are complex and varied, but each component works together to realize the perception, collection, processing and transmission of environmental information.

3. Fundamentals of Data Fusion Technology

3.1. The definition and principle of data fusion

Data fusion is a kind of information processing technology, which makes use of some observation information obtained by computer in time series, and analyzes and synthesizes it

automatically under certain criteria in order to accomplish the required decision-making and evaluation tasks. Its core is to combine, correlate and combine the data and information of multi-sensor information sources, so as to obtain more accurate location estimation and identity estimation, in order to achieve the battlefield situation and threat and its importance of real-time, complete evaluation. Data Fusion firstly collects the data information of the observed target through many different types of sensors. Then, the output data of the sensor is extracted to get the feature vector representing the observed data. Then the feature vector is recognized, such as using clustering algorithm, adaptive neural network or other statistical pattern recognition method which can transform the feature vector into target attribute decision. Then the data of each sensor about the target are grouped by the same target, that is, association. Finally, the fusion algorithm is used to synthesize the sensor data of each target to obtain the consistent interpretation and description of the target. This fusion process not only improves the accuracy and reliability of data, but also reduces data redundancy and noise interference, thus enhancing the effectiveness of decision-making and evaluation. Data fusion technology has been widely used in military field, such as battlefield situation awareness, target detection and tracking, and also in civil field, such as Environmental monitoring, intelligent transportation^[4].

3.2. Application of data fusion in sensor networks

The application of data fusion in sensor networks is very extensive and important. Its main role is to save energy, improve the accuracy of the data collected and improve the efficiency of data collection. First, in terms of energy savings, data fusion reduces energy consumption by reducing the amount of data transmitted. Because the energy consumed by the sensor node to transmit data is much higher than the energy consumed by calculation, the redundant data is processed and the redundant information is deleted in the network, it makes the transmitted data as little as possible under the premise of meeting the application requirements, thus effectively saving energy. Second, data fusion can significantly improve the accuracy of the data collected. By using multi-sensor information, the uncertainty and limitation of single sensor can be overcome, and the data fusion can describe the measured object completely and accurately. For example, when multiple sensors monitor the same object, the accuracy and reliability of information can be effectively improved by integrating the data collected by them, filter out the data that may have errors or larger errors in individual nodes^[5].

Finally, data fusion can improve the efficiency of data collection. Reducing the amount of data needed to be transferred not only reduces the delay of data transmission, but also effectively reduces the congestion of data in the network, and reduces data conflicts and collisions in the process of transmission, therefore, the utilization ratio of the whole network wireless channel is improved. In specific applications, data fusion technology is mainly used to process the same type of sensor data. For example, in forest fire prevention applications, environmental temperature data detected by multiple temperature sensors need to be fused; in automatic target recognition applications, it is necessary to fuse the image data collected by the image monitoring sensor. These applications show that data fusion plays an important

role in improving data quality and processing efficiency in sensor networks. In conclusion, the application of data fusion in sensor networks can not only save energy and improve data accuracy, but also enhance the efficiency of data collection.

4. The Basis of Artificial Intelligence Algorithms

4.1. Overview of artificial intelligence algorithms

Artificial Intelligence (AI) algorithm is a method to simulate human intelligence through data analysis and pattern recognition^[6]. They are collections of instructions and rules designed to solve complex problems, automate tasks, make decisions, or simulate human cognitive processes. Artificial intelligence algorithms often use machine learning and deep learning techniques to train models based on statistical principles and pattern recognition by analyzing and understanding large amounts of data, allow the model to accurately predict new data. The main goal of artificial intelligence algorithm is to improve the level of computer intelligence, so that it can handle more complex tasks, such as self-driving cars, dialogue robots. In addition, artificial intelligence algorithms also aim to improve production efficiency and quality by automating and refining production processes to reduce costs and product losses and improve product quality. For example, in machine vision and image recognition, artificial intelligence algorithms can detect errors and defects in products and automate various processes in production. At present, there are many kinds of artificial intelligence algorithms, including artificial neural network genetic algorithm, simulated annealing algorithm, swarm intelligent ant colony algorithm and so on. These algorithms are widely used in various fields, such as image recognition, speech recognition, natural language processing, machine translation, prediction and recommendation. In a word, artificial intelligence algorithm is a kind of computer technology which simulates human intelligent behavior and learning ability. Through the analysis and learning of large amount of data, it enables the computer to automatically perform complex tasks and make decisions, and constantly improve its performance to better respond to new challenges and situations.

4.2. Depth learning algorithm

Deep learning algorithm is an important branch of artificial intelligence, which is based on neural network model and simulates the connection and interaction between human brain neurons, to realize complex feature extraction and pattern recognition of data. The core of the deep learning algorithm is to construct a deep neural network, which consists of multiple hidden layers, each layer processes the output of the previous layer through nonlinear transformation, to extract a higher-level feature representation. This hierarchical feature extraction approach enables deep learning algorithms to deal with complex data patterns and has made significant progress in areas such as image recognition, speech recognition, and natural language processing^[7]. Common deep learning algorithms include convolutional neural network, recurrent neural networks, short-and long-term memory networks, etc. . CNN is particularly suitable for image processing tasks, which extract local features from images by convolution and pooling, while RNN is suitable for processing sequential data, such as text or time series, LSTM

is a variant of RNN, which solves the problem of gradient disappearance or explosion when RNN processes long sequence by introducing memory unit. In the field of target detection, depth learning algorithm also plays an important role. For example, the target detection algorithm based on depth learning can be divided into two-stage algorithm and one-stage algorithm. Two-stage algorithm, such as R-CNN series, need to filter the candidate box first, and then determine whether the candidate box in the target to be detected, and to modify the position of the target; The one-stage algorithm regresses the position coordinate of the target box and the classification probability of the target directly, without the process of filtering the candidate box. In a word, deep learning algorithm realizes feature extraction and pattern recognition of complex data by constructing deep neural network model, which provides strong technical support for the development of artificial intelligence.

4.3. Machine learning algorithms

Machine learning algorithms are an important branch of artificial intelligence, which study how computers simulate or implement human learning behaviors in order to acquire new knowledge or skills, and reorganize the existing knowledge structure to improve its performance. Machine learning algorithm involves many subjects, including probability theory, statistics, approximation theory, convex analysis, algorithm complexity theory and so on. There are many kinds of machine learning algorithms, each of which has its specific application scenarios and advantages. Linear regression is a predictive modeling technique that tries to find the best straight line to minimize the sum of squares of errors between predicted and observed values. Logistic regression is a regression analysis method used to deal with dichotomous problems. It converts the output of a linear regression model into a probability value by using a logical function. According to the attribute of data, decision tree algorithm uses tree structure to establish decision model, which is used to solve classification and regression problems. This algorithm is easy to understand and realize, and can deal with nonlinear relations.

The K-nearest neighbor algorithm is a Instance-based learning, or lazy learning of local approximation and postponing all computation until after classification. KNN classifies by measuring the distance between different data points. Random Forest: a random forest is a classifier that contains multiple decision trees. The output category is determined by the mode of the category output from the individual tree. This method can improve the accuracy and stability of prediction by constructing multiple models. Then there are deep learning algorithms, Support vector machine, Naive Bayes, ensemble learning and many more. Each algorithm has its own unique advantages and applicable scenarios, so in practical applications, we need to choose the appropriate algorithm according to specific problems and data characteristics. Machine learning algorithms are widely used in many fields, such as natural language processing, image recognition, recommendation system, financial risk control^[8]. With the development of big data and computing power, machine learning algorithms will play a more important role in the future, driving the development and innovation of artificial intelligence technology.

5. Data Fusion Technology Based on Artificial Intelligence Algorithm

5.1. Data fusion framework based on artificial intelligence

The data fusion framework based on artificial intelligence (AI) is a comprehensive solution that combines AI technology and data fusion methods to improve the efficiency and accuracy of data processing, to provide users with more reliable, more valuable information. The first is data acquisition and preprocessing, the first step in data fusion, which involves collecting data from a variety of sensors, data sources or systems and performing the necessary cleaning, conversion and standardization processes, to ensure data quality and consistency. The second is feature extraction and selection. On the basis of pretreatment, feature extraction and selection are carried out by using artificial intelligence technology (such as deep learning, machine learning, etc.) . This step aims to extract meaningful features from the original data and provide a basis for subsequent data fusion and analysis.

The next step is the data fusion algorithm, which is the core part of the framework and involves the use of artificial intelligence algorithms to fuse information from multiple data sources. These algorithms can be customized according to the characteristics and requirements of the data to achieve more accurate and comprehensive information fusion. Common data fusion algorithms include weighted average, Bayesian inference, Kalman filter, neural networks, etc. . Finally is the result output and the visualization, after the data fusion processing, the result output in the visual form, is convenient for the user to understand and use. This may include diagrams, reports, or other forms of visualization tools. Artificial intelligence-based data fusion frameworks are widely used in areas such as Environmental monitoring, intelligent transportation, and health care. It can help users better understand and use complex data sets, improve the accuracy and efficiency of decision-making. It is worth noting that with the continuous development and improvement of artificial intelligence technology, the data fusion framework based on artificial intelligence is also constantly updated and optimized. In the future, we can expect more efficient, accurate and intelligent data fusion solutions to provide stronger support for the development of various fields^[9].

5.2. Data fusion method based on deep learning

The data fusion method based on deep learning combines deep learning technology and data fusion strategy to process and parse information from different sources more effectively. Feature level fusion is the fusion feature in the early stage of deep learning model. For example, in convolutional neural network (CNN) , features can be extracted from different input sources and either concatenation or addition of these features can be fed together into a subsequent network layer for further processing. Feature extraction and fusion is to extract features from data sources by using deep learning model, and then fuse them in feature space. This can be achieved by simple feature stitching, weighted fusion, or by using more complex fusion networks.

The decision fusion of independent models is to train independent deep learning models for each data source, and then combine the outputs of these models to make decisions.

This can be achieved by voting, weighted averaging, or other strategies. Ensemble learning is the use of ensemble learning techniques, such as bagging or boosting, in combination with multiple deep learning models to improve the overall performance of the predictions. Feature-level and decision-level fusion is the first feature-level fusion, and then based on the fusion of the characteristics of the decision-level fusion. This method combines the advantages of feature-level and decision-level fusion and may achieve better performance. Custom Fusion Network is a special deep learning network structure designed to integrate data from different sources. For example, you can use a multi-input, multi-output network structure where each input corresponds to a data source and the output is the result of fusion. The attention mechanism is to introduce the attention mechanism, so that the model can automatically learn the relative importance between different data sources and adjust dynamically according to needs. The joint training integrates the fusion strategy into the training of the deep learning model, and optimizes the joint training in an end-to-end manner to ensure the maximum performance. The design of loss function is to design a proper loss function to guide the training process of the model and ensure that the fusion result can accurately reflect the information of multiple data sources. It should be noted that data fusion methods based on deep learning need to be selected and adjusted according to specific application scenarios and data characteristics. Different fusion strategies and methods may exhibit different performance on different tasks, so sufficient experiments and validation are needed to determine the optimal scheme.

5.3. Data fusion method based on machine learning

The method of data fusion based on machine learning is to apply machine learning algorithm to the process of data fusion in order to integrate and extract the information from different data sources. Feature stitching is the process of stitching feature vectors from different data sources into a longer feature vector in a certain order, and then taking it as the input of machine learning model. This method is simple and direct, but needs to pay attention to the order and dimension matching between features. Feature selection and Manacor can use feature selection technology to select the most representative features before stitching features, and use dimensionality reduction technology to reduce feature dimensions and improve computational efficiency. The voting method is to vote on the prediction results of multiple machine learning models, and determine the final prediction results according to the principle that the minority obeys the majority. This can be either a normal voting method or a weighted voting method that sets weights based on model performance. The average method includes arithmetic average, geometric average and weighted average. The arithmetic average takes the average of all the predictions of the models, the geometric average takes the product of the predictions, and the weighted average takes the average after different weights are given according to the performance of the models. Stacking involves taking the output of one model as the input of another, or combining the outputs of multiple models to make a final prediction. This method can make use of the advantages of different models to improve the prediction accuracy.

In order to get the final prediction result, the fusion is to sort the prediction results of several models, and then take the

average of the results or normalize them. This method considers the relative order of the results of different models, which is helpful to make full use of the information of each model. When the data of some data sources are large or well labeled, they can be used to train a better machine learning model, the model is then migrated as a pre-training model to other data sources for fine tuning. This method can make full use of existing data resources and improve the fusion effect of new data sources. It is necessary to choose proper machine learning algorithm and parameter setting to ensure the best fusion effect. In addition, cross-validation and regularization techniques can be used to prevent over-fitting and improve the generalization ability of the model^[10].

It should be noted that ml-based data fusion methods need to be selected and adjusted according to specific application scenarios and data characteristics. Different fusion strategies and methods may exhibit different performance on different tasks, so sufficient experiments and validation are needed to determine the optimal scheme. At the same time, attention needs to be paid to data quality and labelling to ensure the accuracy and reliability of the fusion results.

6. Application of Data Fusion and Analysis in Sensor Networks

6.1. Environmental monitoring and protection

Data Fusion and analysis in sensor networks play a crucial role in Environmental monitoring and protection. A sensor network usually consists of a large number of sensor nodes distributed in a specific area, which can collect environmental data in real time and transmit and process it through the network. Data Fusion and analysis technology is the key method to integrate, extract and analyze these data. On the Environmental monitoring side, sensor networks enable comprehensive monitoring of a wide range of environmental media, including the atmosphere, water quality and soil. Each sensor node collects data on environmental parameters such as temperature, humidity, air pressure, and pollutant concentrations. However, due to the complexity of environmental factors and the limitations of the sensor itself, these data often have problems such as noise, redundancy and inconsistency. Therefore, data fusion technology is particularly important. Data fusion technology can integrate and coordinate data from different sensor nodes, eliminate redundancy and noise, and improve data accuracy and reliability. For example, weighted averaging and Kalman filter methods can be used to fuse data from multiple sensor nodes to obtain more accurate estimates of environmental parameters. In addition, data fusion can also be based on the spatio-temporal characteristics of data correlation analysis, revealing the trend of environmental change and laws. In the aspect of data analysis, the nature and source of environmental problems can be further revealed through in-depth mining and pattern recognition of the fused data. For example, the use of machine learning algorithms to analyze environmental data from long-term series can predict environmental pollution trends and potential risks; by comparing and associating environmental data from different regions, it can reveal the spatial distribution characteristics and influencing factors of environmental pollution.

Based on the results of these data fusion and analysis, environmental protection departments can develop more accurate and effective environmental protection measures. For example, based on the results of the analysis of air

pollution data, measures such as optimizing the industrial layout, adjusting the energy structure and strengthening emission control can be taken; based on the results of the analysis of water quality monitoring data, it can strengthen water source protection, control water pollution, improve water ecology and other measures. In addition, data fusion and analysis techniques can provide decision support for Environmental monitoring and protection. Through the comprehensive analysis of historical data and real-time data, we can evaluate the effect of environmental protection measures and provide a basis for policy formulation and adjustment. At the same time, data fusion and analysis technology can also help discover new environmental problems and potential risks, and provide early warning and forecasting functions for environmental protection. In summary, data fusion and analysis in sensor networks play an important role in Environmental monitoring and protection. They not only improve the accuracy and reliability of Environmental monitoring, but also provide the scientific basis and decision support for the formulation and implementation of environmental protection measures. With the development of technology and application, it is believed that data fusion and analysis will play an important role in the field of Environmental monitoring and protection.

6.2. Intelligent transportation system

Data Fusion and analysis in sensor network plays a key role in intelligent transportation system (its) , which can effectively improve the operational efficiency and security of transportation system. Below, I explore the application and impact of this technology in several key ways. Firstly, sensor networks play an important role in the perception layer of intelligent transportation system. These sensors can collect real-time traffic information of road, vehicle and pedestrian, including vehicle speed, traffic flow, road condition, pedestrian flow and so on. This information provides important data support for the decision-making of its. Second, the data fusion technology will be from different sensors, different sources of data integration and coordination. Because there are many nodes in the sensor network, and each node may produce a lot of data, so data fusion technology can eliminate redundant information, reduce noise, and improve the accuracy and reliability of data. This technique provides a complete and unified view of the traffic environment by correlating data from different sensors.

Next, the data analysis technology further excavates these data behind the information and the rule. Through the application of machine learning, depth learning algorithms, traffic flow, traffic patterns, traffic congestion can be analyzed and predicted. These results can provide decision support for traffic management, such as optimizing traffic signal control strategy, adjusting traffic routes, planning traffic facilities, etc. . In addition, data fusion and analysis technology can also be used to realize the automation and intelligence of intelligent transportation system. For example, by analyzing the dynamic information of vehicles and pedestrians in real time, potential traffic conflicts can be predicted and traffic signals can be automatically adjusted or warned to prevent traffic accidents. At the same time, this technology can also be used to achieve the navigation and decision-making of autonomous vehicles, improve the safety and reliability of autonomous driving. In a word, data fusion and analysis in sensor networks have a wide application prospect in intelligent transportation system. They can improve the

intelligent level of traffic system, improve traffic efficiency, reduce traffic accidents, and provide people with a more safe, convenient and comfortable experience. With the continuous progress of technology and deepening of application, it is believed that more remarkable results will be achieved in this field.

6.3. Health care

The application of data fusion and analysis in sensor networks in the field of medical and health care has brought unprecedented opportunities and challenges for modern medical treatment. Such applications not only improve the efficiency and quality of medical services, but also provide patients with more personalized and accurate treatment. First of all, the application of sensor networks in the field of health care has realized the real-time and continuous monitoring of patients' physiological data. By deploying a variety of sensors, such as heart rate monitors, blood pressure monitors, and glucose meters, on the patient or in the surrounding environment, the physiological data of the patient can be collected in real time, and transmit it to the medical data center for analysis. This kind of continuous monitoring is helpful for doctors to find out the abnormal condition of patients in time and take corresponding treatment measures. Second, the data fusion technology will be from different sensors, different time points of data integration and coordination, to form a comprehensive, accurate patient health portrait. Because different sensors may collect different types of data, and there may be redundancy or conflict between the data, so data fusion technology can eliminate these problems, improve the accuracy and reliability of data. This helps doctors to understand the patient; health more comprehensively and develop more accurate treatment plans.

In addition, the data analysis technology further excavates the information and the rule behind these physiological data. Through the application of machine learning and deep learning algorithms, we can analyze the physiological data of patients by pattern recognition and trend prediction, so as to find potential health risks or early signs of disease. This predictive analysis helps doctors intervene in advance to prevent further development of the disease. However, such applications also face challenges such as data privacy and security issues, accuracy and reliability of sensor devices, and how to process and analyze large amounts of physiological data. Therefore, these problems should be fully considered and effective measures should be taken to solve them when applying data fusion and analysis techniques in sensor networks. In short, the application of data fusion and analysis in sensor networks in the field of health care has broad prospects and potential. With the continuous progress of technology and deepening of application, I believe that this technology will bring more innovations and breakthroughs for modern medicine.

7. Conclusion and Prospect

The technology of data fusion and analysis in sensor networks has shown its great application potential and value in many fields. From Environmental monitoring and protection to intelligent transportation systems to health care, the applications of these technologies provide us with more accurate, comprehensive and real-time data to support decision-making. In conclusion, we can clearly say that the application of data fusion and analysis technology in sensor

networks not only improves efficiency and accuracy, but also brings revolutionary changes to the development of various fields. Especially in the field of health care, through the real-time monitoring and analysis of patients' physiological data, we can provide patients with more personalized and accurate treatment programs, which can further improve patients' quality of life. However, we must also see that although the technology of data fusion and analysis in sensor networks has made significant progress, there are still many challenges and problems to be solved. For example, how to further improve the accuracy and reliability of data, how to optimize algorithms to improve processing efficiency, how to ensure data security and privacy protection.

In the future, with the rapid development of Internet of things, big data and artificial intelligence, the application of data fusion and analysis in sensor networks will be more extensive and in-depth. We can foresee that the future sensor networks will be more intelligent, efficient and secure, providing more solid technical support for the sustainable development of various fields. We therefore need to continue to increase research and investment in this area and to constantly explore new technologies and methodologies to meet the increasingly complex and diverse challenges. At the same time, we also need to strengthen cross-field cooperation and exchanges, and jointly promote the development and application of data fusion and analysis technology in sensor networks.

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