Research on the Wireless Sensor Network Management Methodologies Based on the Runtime Model

Wenzhun Huang[1,a], Shanwen Zhang[1,b]

[1]Department of Electronic Information Engineering, Xijing University, Xi'an 710123, China

[a]huangwenzhun@xijing.edu.cn; [b]huangwenzhun@xijing.edu.cn

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Abstract. In this paper, we conduct research on the wireless sensor network management methods based on the runtime model. With the deepening of the research, scalability and maintainability of wireless sensor network has become an important target of its application promotion. Consider that the nodes randomly distributed monitoring area, looking for a complete coverage of this area several disjoint nodes, use genetic algorithm to optimize the network survival time nodes and corresponding coverage. From the point of view of software engineering, most of the specific software system knowledge hidden in the program and document, the model as the main content of the document and procedures of high-level abstractions. The management of the network is urgently needed. The numerical simulation shows that our method performed better compared with other related approaches. In the future, more research will be conducted to polish the current method.

Introduction

Wireless sensor network is a distributed sensing information system, composed of spatial distribution and collaborate more nodes. These nodes have very limited computation, wireless communication and storage space and energy. With the deepening of the research, scalability and maintainability of wireless sensor network has become an important target of its application promotion. The wireless sensor network has the characteristic such as limited resources and the diversity of hardware and application, makes wireless sensor network application development and deployment are difficult. This requires developing the middleware architecture, providing appropriate abstraction layer to hide operating systems and hardware technical details, under the condition of the limited energy resources to deploy applications to the wireless sensor network so quickly. Wireless sensor network is composed of a ubiquitous and the tiny sensor nodes with wireless communication and computing ability of self-organizing distributed communication network system, more is to be able to finish the task given their own according to environment intelligent collaborative system. Wireless sensor network to realize the high fidelity of a large number of distributed space-time data sampling, but in general applications of sampling frequency of sensor nodes is usually fixed, and the adaptive sampling frequency sampling technique, the changes according to the measured object, when the observation object changes slowly lower sampling frequency, when the observation object changes rapidly increase the sampling frequency [1-3].

At present, the wireless sensor network survival time optimization algorithm mainly includes: static survival time of wireless sensor network optimization algorithm and has a single mobile nodes of wireless sensor network survival time optimization algorithm. Consider that the nodes randomly distributed monitoring area, looking for a complete coverage of this area several disjoint nodes, use genetic algorithm to optimize the network survival time nodes and corresponding coverage. Data collected by the sensing device is in real time, large number and without good structure, to apply mapped to the data collected in the scene object attributes, objective things had to write a lot of conversion code, facing two main challenges. On the one hand is the diversity of the device type, there are different types of sensor devices on the different information such as sound, light, location, monitoring, and different types, different brand, even different types of sensor devices often provide

different ways of data read, therefore, the diversity of the device type has brought information gain greater complexity. On the other hand is a management services on demand, there are different types of applications [4-6]. IOT system is actually in the objective world of all kinds of information collection, analysis and decision making process, from the perspective of system implementation, the application system need to use the sensing device provides the management interface for all kinds of information, and in view of the specific application scenario for the information analysis and processing [7].

IOT system development the main problem is: the problem domain and the system implementation, there is a gap between the problem domains is achieved by hard coded into the system to realize mapping will bring huge programming complexity. The software architecture with a set of manageable unit to represent the overall architecture of the system, and can play a bridge between the system requirements and system, is used to solve the demand to realize the process of mapping problem brought by the complexity of system [8]. From the point of view of software engineering, most of the specific software system knowledge hidden in the program and document, the model as the main content of the document and procedures of high-level abstractions, is the ideal software and the carrier of knowledge management. The runtime software architecture model with a set of manageable unit to represent the overall architecture of the system, and through will hide in the system of internal structure, status, configuration and runtime information display to describe as a standard, management perspective oriented structural view, can effectively improve the development of IOT systems of abstraction and automation. The runtime software architecture model has won the wide attention in academia and industry. A lot of research work proved it under different system and management mode of important role. In the figure one, we show the general topology of WSN.

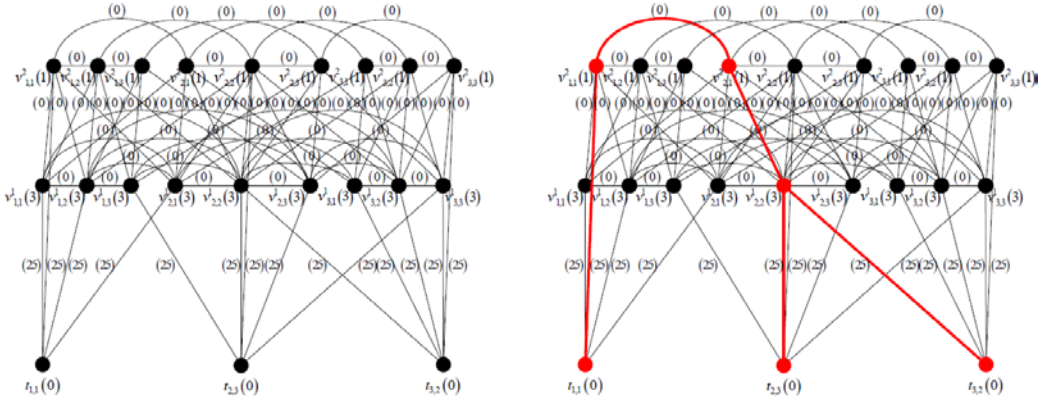

Fig. 1 The General Topology of the Wireless Sensor Network

In this paper, we conduct research on the wireless sensor network management methodologies based on the runtime model. Cluster head nodes according to the history of the sensory data model and the current sampling data of a sentence, whether according to meet the demand of precision of sampling. If the sensor sampling data within a cluster of dynamics is lower, the lower sampling frequency in order to reduce the redundant data generation and transmission, if the sensor of the dynamic characteristics of the sampling data is higher, then improve the data sampling frequency to ensure the quality of data sampling, which realizes the network energy efficient and the balance between the two data acquisition quality. In the following sections, we will discuss the issues in detail.

Our Proposed Methodology and Approach

The Runtime Model and Cloud Environment. Cloud resources run time model is generally practical hardware and software system of abstract in cloud environment, the construction method of input including system model and access model, among them and the model describes the managed information system, access model describes the management of the call interface methods. Cloud management is, in fact, the cloud resource management, and different management requirements of target managed resources also each is not identical [9]. Thus, we put forward the combined methods

of distributed runtime model, runtime model in cloud resources, on the basis of in the form of a portfolio model to the organization, implements a variety of cloud resources unified management, the main work includes model customization and data synchronization.

Dynamically adjust processor core resources between different application load and its internal distribution and management. Centralized performance for processor cores by resources unified controller that is allocated to the runtime environment, to ensure the fairness and effectiveness of resource allocation, and processor core resources independently by the runtime environment, distributed management and scheduling, ensure the flexibility of resource use. Advantage is fully embodies the multi-core programming model good programmability and portability, eliminates the traditional multicore runtime environment explicitly specify the number of nuclear, enhances the processor core resource allocation efficiency and adaptability. Currently supports multi-core programming model of runtime environment are independent of each other, each other which can't communication when a variety of mixed programming model, overall system performance optimization, and the current operating system also lack for different multi-core programming model performance optimization method of the runtime environment makes the new programming model in the larger performance bottlenecks in practical application [10].

Customized model pieces need to be able to run from the cloud resource model for the managed resource information, namely the identification of model fragments. Cloud resources run time model and the user customization model fragment is stored in the form of an XML file, for each element in the model, has one and only one path from the root node can locate to the element. The combination model of model fragments from different cloud resource runtime model, they are not grammatical correlation. Therefore, we will each root node of the model fragment as the combination model of the root node direct child nodes. At the same time, in order to solve the model fragment naming conflicts, we also need to maintain a namespace and name to replace the conflict and record. Inside the portfolio model, named element using the new will not conflict, and when the combination model and the runtime model interaction occurs, was named element is changed according to the namespace to restore original name that can be run time model identification. In the model on the basis of custom, only maintain combination model and the system is running model of data synchronization, to achieve the unity of the combination model of multiple systems management. Portfolio model made of different elements of the system is running model, the data consistency by the different model fragments were completed. Model fragment operations through the model of transmission and perform to implement the data synchronization. On the one hand, when the administrator to manipulate, the portfolio model its model of operation will be sent to the system is running model and implementation. Runtime model in the system, on the other hand, the deployment of a copy of the model fragment, by polling mechanism is found that the change of the model, to automatically generate the corresponding model, sent to the portfolio model and executed. In the figure two, we demonstrate the basic concept of the runtime model.

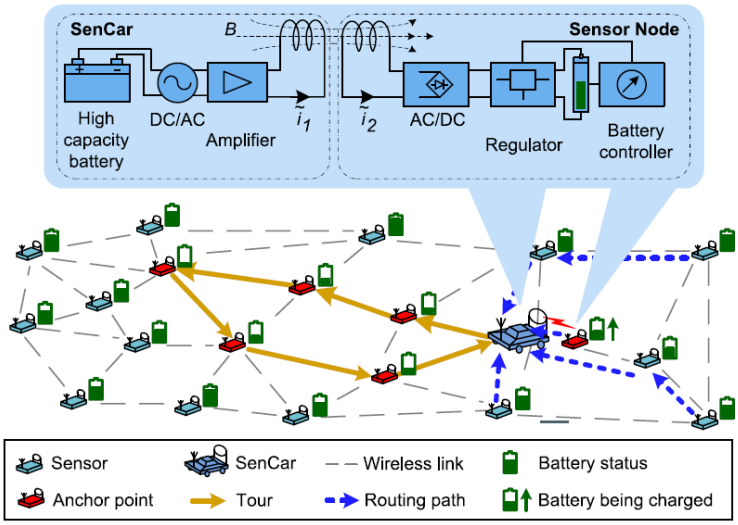

Fig. 2 The General Demonstration of the Runtime Model

The Wireless Sensor Network Management. Clustering network structure has the feature of good expansibility, can provide convenient energy management mechanism, the load balancing, resource allocation and data fusion processing all have good performance, such as for unicast, multicast, and broadcast communication is very efficient. Wireless sensor network is different from the Ad hoc network, the node after setting, generally less mobile, so there is no Ad hoc based network due to node mobility of the network topology changes frequently. For this kind of "quasi static network, frequent for tech-oriented of clustering is not necessary, therefore, in the initial stages of clustering nodes try to collect the perimeter of the network information, and make a local optimal choice, accordingly in order to get more stable clustering structure, reduce tech-oriented to the number of clustering, although in the early to do so more information interaction, but to prolong the network life cycle is beneficial. The node structure is shown in the following figure.

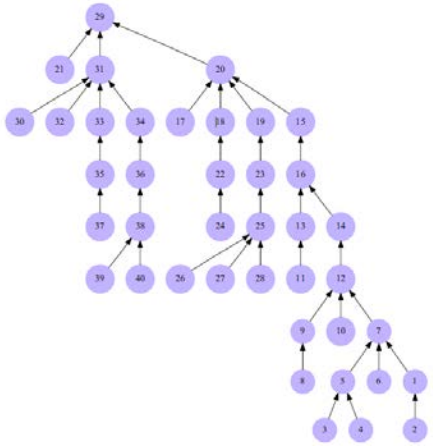

Fig. 3 The Node Structure of the Wireless Sensor Network

For perception and gathering information about network coverage range detection object, and jump for short distance wireless communication mode to analysis and processing monitoring data sent to the gateway which is shown in the following formula.

$$I\left(x,y,z,t\right)=\left[\mathrm{S1},\mathrm{S}2,...,\mathrm{Sm}\right]^{'}|_{(x,y,z,t)} \tag{1}$$

In the process of the data transmission of wireless sensor network, transmission distance, interference and multipath fading factor will decrease the rate of the success of package receiving. Studies have given the following conclusion: in noise power and the packet length must be a certain circumstances, the closer from the sending node of the corresponding received signal power is stronger, the signal-to-noise ratio, the greater the package to receive the higher the rate of success. Considering the influence of various negative factors, package receiving rate of success is not entirely decreases with the increase of the distance it also has some unexpected.

Because of the wireless sensor node microprocessor under homogeneous configuration need management under the module more than heterogeneous configuration scheme of management module, and the need to deal with protocol communication task than heterogeneous manner to deal with protocol communication task, so it can deduce the microprocessor in the wireless sensor node than heterogeneous isomorphism under the configuration and the related scheme of work time under the configuration scheme of work time.

$$y=\sum_{x\in\Theta}a_{x}h_{x}\left(\theta+\eta_{x}\right)+v \tag{2}$$

Under the wireless sensor node in homogeneous configuration scheme adopts star network cluster method, each sensor node of sensory information through the cluster head nodes will be sent to the rear database for data fusion. According to the save energy of nodes and prolong survival time of the timing system polling way up. Data correlation clustering mechanism data correlation is the main train of thought of the strong f embodied in physical space position and average data is relatively close to the sensor nodes in a cluster, each sensor node in a cluster of centralized data model predicts that the cluster head node is responsible for maintaining data in each cluster model to reduce the redundancy of data, improve the efficiency of energy use. Most of the time be monitored environment

generally do not have events; If events, events will continue for a period of time, generally within the sliding window other moments will detect the occurrence of the event. Sensor nodes in a certain period of time the readings will be related to each other so should make full use of the node in different time to collect data effectively for the event to determine.

Event boundary nodes on both sides of the edge of the area are distributed in the event, in fact, the node data thus collected were divided into two classes. The cloud resource runtime software and hardware system of abstract model is a cloud environment. The administrator only managed modules to the system of information and system management of the call interface method is described, the construction method can generate the corresponding runtime model cloud resources, and support the runtime model with the state of the system automatic synchronization. So, the administrator can manage the cloud resources in the model layer. Event boundary detection algorithm based on the classification principle of design, when within the neighborhood of a node can be collected at one point the data is divided into two class, is the node can be judged event boundary nodes. Events and event boundary detection algorithm with fault-tolerance ability at the beginning of the sensor nodes to collect the data of the initial stage, the first to perform fault detection algorithm if found node event boundary conditions, the decision for the event boundary nodes, or to determine the fault node, and the execution node information reliability recovery mechanism if convicted for normal nodes, then continue to execute event boundary detection algorithm and the node information reliability recovery mechanism. No matter what kind of results, finally for node will continue to collect data, and perform the incident detection algorithm. Therefore, in this work we present a performance analysis of distributed estimation in WSN employing a stationary based framework to characterize the stochastic geometry of such networks. Since, it is based on a random analysis of WSN and it has a good practical utility as it can be used in scenarios with irregular placement of sensor nodes. In the next section, we will test our proposed method with more other state-of-the-art methodologies.

Experimental Analysis and Simulation

In this part, we conduct numerical analysis and simulation on the proposed methodology. Of the increase of sampling frequency adaptive adjustment adopts half way to adjust: when the sampling error is less than the preset threshold, halve each sensor in the clustering sampling frequency, or increase the sampling frequency, increase the step value of maximum threshold value and lower threshold. Finally limit adjusted sampling frequency in the upper threshold and lower threshold value range. In order to achieve the specific management functions, often need to spread in some specific area sensor collected data integration equipment. Administrators need to according to the management requirements, on the basis of the sensing device runtime model, select on behalf of the target data model fragment, this method can automatically generate the corresponding portfolio model, and support a portfolio model with a single runtime data synchronization of the model. Then, the administrator can in the form of combination model of target sensing device for unified management. In order to achieve different gradient cluster head load balancing, adopt the method of cluster weight more point, group of gradient nodes can have uniform organized into clusters, cluster load balance of the same gradient. To measure precision, the error of the prediction error using the average relative error index forecast to characterize the degree of deviation from the actual data. As shown in Figure 4, we show the numerical analysis and simulation of the proposed method.

Conclusion and Summary

In this paper, we conduct research on the wireless sensor network management methodologies based on the runtime model. We put forward a kind of resources under the condition of limited support can be dynamically loaded wireless sensor network node middleware architecture. Detection and event boundary detection is one of the important applications of wireless sensor network and the node failure accurate detection is the precondition of improving the efficiency of events and event boundary detection. However, the current fault detection mechanism analysis of node failure type is

not clear, causes the system could be mistaken for fault event boundary node, and often need for frequent communication between sensor nodes, utilization rate is low, lead to network system fault tolerant performance and node and additional energy costs. In the experimental part, we compare our method with other state-of-the-art algorithm and get the positive feedback. In the future, we plan to conduct more related research to enhance the feasibility of the current approach.

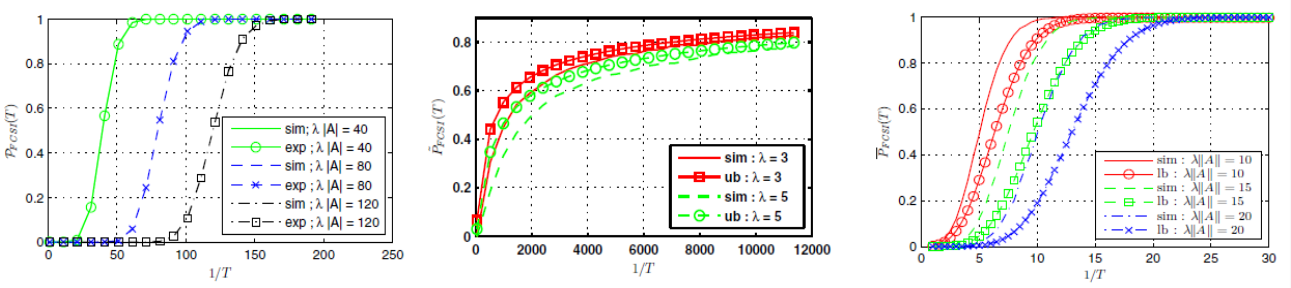

Fig. 4 The Experimental Analysis and Result of the Proposed Methodology

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