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The Optimization Algorithm of Wireless Sensor Network Node Based on Improved Ant Colony

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Abstract: Ant colony optimization algorithm is a way to be used to find the optimal solutions is enormous, the number of ants on the path, which will lead to reduced the network node on the path energy drastically. The wireless sensor network is a large number of tiny sensor nodes with communication and computing power. Using wireless sensor networks collaboration to perception, the perception of the object information acquisition and processing in the network coverage area, and send to the observer. This paper describes the basic principles and characteristics of the algorithm and the improved ant colony algorithm, ant colony algorithm in wireless sensor network node. The paper presents the optimization algorithm of wireless sensor network node based on improved ant colony. In order to verify the performance of the algorithm, the paper establishes a wireless sensor network simulation environment in Matlab. *Copyright © 2013 IFSA.*

Keywords: Ant colony, Wireless sensor network, Optimization.

1. Introduction

Ant colony algorithm (ant colony optimization, ACO), also known as ant algorithm, the probability type technology is a way to be used to find the optimal solution. Inspired by the behavior of ants found in the process of looking is in order for food path. When ants move forward on the path to choose their path to go based secretions the ants traveled by the front left. The probability of selecting a path is proportional to the intensity of secretions in the path. Therefore, the collective behavior of the group consisting of large number of ants' positive are feedback phenomenon in fact constitute a learning information: a path through ants more, greater ants behind the possibility to select the path. Individual ants seek the shortest path to the food through the exchange of such information.

Wireless sensor network node processor / radio frequency communication board and sensor board. The processor/radio frequency communication board with a MSP430F149 microcontroller and a variety of operating modes of the ultra-low-power radio frequency (RF) chip nRF905, sensor board with a sound, acceleration and magnetic properties of three sensors for environmental data collection and target the detection of the information, buzzer, microphone, and the reception of the audio signal amplification and decoding circuitry at the same time to achieve ranging between nodes. The system uses two battery-powered. Aggregation node is using the same structural design and ordinary sensor nodes.

Ant colony algorithm ants through pheromone path to reach the destination, so if the path is the optimal path to reach the destination, the number of ants in the path would be great [1]. This will lead to the path on the network node energy drastically reduced to shorten the life cycle of the entire network, and is likely to lead to the path congestion ant colony algorithm easy to fall into local optimal

solution, the performance of the routing information table stagnation, so when network topology changes, the artificial ants soon found new better path. In order to solve these problems, it is necessary to improve the ant colony algorithm, network data flow through different possible delay countdown.

Ant colony optimization algorithm is a simulated ants foraging behavior of analog optimization algorithm, it is first proposed in 1991 by the Italian scholar Dorigo M, et al, after study the basic principles and mathematical models of the ant colony algorithm, combined optimization problems with genetic algorithms, taboo search algorithm, simulated annealing algorithm, hill climbing simulation experiments laid the foundation for the development of the ant colony algorithm, and attracted the attention of scholars and research around the world.

Wireless sensor network (Wireless Sensor Network, WSN) is deployed in the monitoring area of a large number of cheap micro sensor nodes, formed a multi-hop self-organizing network through wireless communication systems, collaborative sense, acquisition and processing the information of the object is perceived in the network coverage region, and sent to the viewer. Sensors, perception of the object and the observer constitute the three elements of the wireless sensor network. Bi-directional communications as a wireless ad hoc network, the sensor network can be done automatically with the greatest flexibility to the networking of the irregular distribution of the various sensors and control node.

Ant colony algorithm is based on this characteristic; imitate the behavior of ants, in order to achieve optimization. This algorithm is different from the traditional programming model, its advantage to avoid the lengthy programming and planning, the program itself is based on certain rules randomly run to find the best configuration. That is, when the program most find the target, the path is almost impossible to be optimal and may even contain numerous errors choice extremely lengthy. However, the program can find food by ants when the principles of the pheromone, continue to go to fix the original route, so that the entire route is getting shorter, that is, the program execution time is longer, and the obtained path is the more likely close to optimal path. The paper presents the optimization algorithm of wireless sensor network node based on improved ant colony.

2. Optimization based on Improved Ant Colony Algorithm

The ant colony algorithm is introduced: the ant colony algorithm to find the shortest path from ant foraging behavior. Ant colony in search of food sent some ants separately wandering around an ant finds food, it returns to the nest notice companions along the way to leave a letter "pheromones (pheromones, pheromone) as an ant colony to the food location mark. Pheromones gradually volatile if the two ants find the same food at the same time, they take a different route back to the nest, then the compare Raowan a road pheromone smell will be relatively light, ant colony will tend to be along another closer route Go to food seat.

Ant colony algorithm, for a single objective optimization problem, the basic ant colony algorithm based on transition probability search mechanism and the pheromone update, helps to guide the ant groups toward the pheromone concentration high regions of the search, the ants gather in space in a certain area, eventually find the global optimal solution. However, for many objective optimization problem, the solution quality is relative, not absolute optimal, therefore, will usually get a Pareto solution set [2]. Because Pareto solution concentration point can be used as the design of the optimal solution, thus requiring the non-inferior solution set to approximate the real Pareto solution set, and obtained Pareto leading to good.

So the pheromone is the only way to communicate between artificial ants. This method of communication in the use of group knowledge plays a vital role in. In addition, ACO also uses the evaporation mechanism, this point corresponding to the real ant evaporation and hormone. The evaporation mechanism makes the ant colony gradually forget the past history, makes the subsequent ants in the search of less affected by the past bad solution, in order to better guide the ant search direction.

The search for the shortest path is with local mobile. Artificial ants and real ants have the same task, i.e. constructed from origin (Termitomyces) to the destination point (food source) shortest path between local mobile manners. Random state is transition strategies. Artificial ants and true ants are in accordance with the probabilistic decision rules from one state to another neighboring state. Probabilistic decision rule is information and local environment information function. State transition process, artificial ants and true ants only use local information, without the use of forward-looking strategies to foresee the future state [3]. Therefore, the strategy used in time and space is local. Different point of artificial is ants and true ants, as is shown by equation 1.

$$\begin{aligned} D(x,y,\sigma) &= L(x,y,k_i\sigma) - L(x,y,\sigma) \\ &= G(x,y,k_i\sigma) * I(x,y) - G(x,y,\sigma) * I(x,y) \\ &= (G(x,y,k_i\sigma) - G(x,y,\sigma)) * I(x,y) \end{aligned} \quad (1)$$

Elitist strategy ant system (Ant System with elitist strategy, ASelite) was among the first to improve the elitist strategy ant system genetic algorithm, traditional genetic algorithms may lead to best adapt to an individual's genetic information elitist strategy idea is lost retain generation in most elite strategy to adapt to the individual ant system after each cycle to give the optimal solution to this additional amount of pheromone solution is called the global optimal

solution (global-best solution) to find out the solution ants called elite ants (elitist ants), with elitist strategy ant system pheromone is updated according to the following formula.

The ant colony algorithm search behavior of ants is concentrated near the optimal solution can improve the quality of solutions and convergence rate, thus improving the performance of the algorithm. This search method cause premature convergence behavior more prone to Max - Min Ant System (Max-Min Ant System, MMAS) This search method can be an effective mechanism to avoid premature convergence together, so that the algorithm optimal performance.

The more ants walk a path, and then choose the path of the greater probability. This will form a positive feedback, through this positive feedback mechanism; the ant can find the optimal path. As shown in Fig. 1, Fig. 1 node B representation of the nest, said the food source node F. At the beginning, from node B released some ants to F, then they will with equal probability selection of B-C-F, B-D-F and B-E-F branch, each ant to release a certain amount in the path through the pheromone, this information is a certain rate of volatile, ant to judge a path to choose the path of pheromone the largest intensity. In the figure, when return to choose B-D-F branch ant to the node A according to the original road, length of the remaining 2, because the longer path, starting from the node A ants have not returned.

After each cycle in order to take full advantage of the optimal solution loop optimal solution and identified so far, only one ant pheromone update. The ant to find out the optimal solution in the current cycle of ants, ants since the beginning of the experiment, the optimal solution is to find out is to avoid stagnation of the search, track the amount of pheromone on the elements of each solution the value range is limited [τ min, τ max] range initialize the pheromone track for the τ max pheromone track update in MMAS only one ant is updated after each cycle information trajectory revised the trajectory update rules are as follows, using the global optimal solution in the ant colony algorithm mainly use iterative optimal solution in MMAS, as is shown by equation 2 [4].

$$W = (I - \frac{Y_1^* Y_1^T}{Y_1^T Y_1^*} - \frac{Y_2^* Y_2^T}{Y_2^T Y_2^*} - \cdots - \frac{Y_M^* Y_M^T}{Y_M^T Y_M^*})\ W_0 \quad (2)$$

Ant according to the concentration of the pheromone to guide their direction of movement tends to move toward the direction of a high concentration of pheromone the same time, the information factors will gradually over time to evaporate, so the length of the path and the path through the ant much impact on the residual strength of the pheromone. In turn, the strength of the pheromone is to guide other ant's action.

In Directed Diffusion, Sink by flooding request to query the data of each node, and in the SPIN of each node broadcasts its data, for the interested nodes to query data. Through the on-demand query mechanism, Directed Diffusion can effectively reduce the unnecessary data transmission, in order to obtain the better energy-saving effect. The main idea of layered routing algorithm for layered routing algorithms by clustering the data cluster correlation cluster heads aggregate and reduce the need to send the Sink data volume, thereby saving energy consumption. This kind of algorithm is a representative algorithm including LEACH, TEEN etc. LEACH (Low-Energy Adaptive Clustering Hierarchy) algorithm is a typical layered.

Ant colony system state transition rules, q is in a random number Q0 [0, 1] interval uniform distribution determines the size of the use and exploration of the new path between the relative importance of the prior knowledge. The state transition rule known as the characteristics of pseudorandom proportional rule: tend to choose short and has a large number of pheromone edge as the direction of movement, ant colony system global updating rule.

Artificial ant has a dual characteristics: on the one hand, they are an abstraction of the real ants, has the characteristics of real ants, on the other hand, they have some characteristics not found in the real ants, these new features make artificial ants in solving actual optimization problem has a better ability to search for better solutions, as is shown by Fig. 1.

Artificial ants and true ants of the same points: 1. Collaborate are a group of individuals. Real ant colony, ACO is composed by a group of artificial ants, synchronous / asynchronous collaboration between artificial ants to find the optimal solution [5]. Single artificial ants can construct a solution of the problem, but only when the number of artificial ants through mutual collaboration in order to find the optimal (suboptimal) solution. Artificial ant's individuals are to collaborate by write / read state variables.2. The use ectohormone traces and the Stemberg mechanisms. Real ants and it is artificial ants by changing access issues digital status information (called pheromones in ACO) to indirect collaboration.

Features: The principle of ant colony algorithm is a positive feedback mechanism or enhanced learning systems; increased by the increase in the number of ants on the optimal path → pheromone strength → later ant's selection probability increases the number of ants' → optimal path greater increase, to achieve the ultimate convergence on the optimal path [6]. It is a general-purpose stochastic optimization method, it absorbs the behavior of ants Special (internal search mechanism), it is the use of artificial ants the simulation ant system (also known as) to solve the problem L artificial ants is not a actual ants simple simulation, it melt into the human intelligence L artificial ants memory; artificial ants are not completely blind; the artificial ants life of the space-time is discrete.

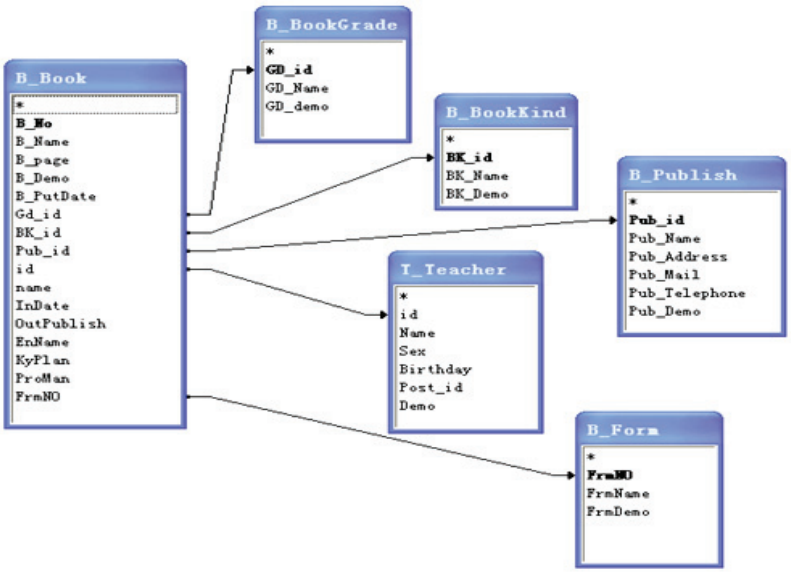

Fig. 1. An ant colony algorithm search behavior of ants.

Based on the above analysis, the basic ant colony algorithm pheromone update makes a new definition. Because it is in the continuous domain, thus distinguished from discrete domains of the situation, the pheromone only retained in the ant position. In order to better guide the ant on the feasible space search, using an external set A (t) for t moment has been found in Pareto solution set. If the ant I to set A (T), the ants in position is now not available, should increase the ant I pheromone, for other ants to ant I position neighborhood search; conversely, if not enter the set A (T), it should be appropriate to reduce the pheromone.

When multiple ant and enter the set A (T), should distinguish each ant pheromone increment to the forefront of Pareto uniformity, the new set A (T) into the ant I and set A (T). Solution of the objective function value of the minimum distance as the ant I in location release pheromones. So, the greater the distance information content is higher, with higher probability guide other ant the ant position neighborhood search as is shown by equation 3.

$$H = \sum_{X \in \Omega_i} \left[\frac{\partial I}{\partial W} \frac{\partial W}{\partial P} \right]^T \left[\frac{\partial I}{\partial W} \frac{\partial W}{\partial P} \right] \tag{3}$$

The artificial ants live in a discrete time, discrete state from a discrete state to another; artificial ants have internal state of the memory capacity of the artificial ants can remember walking along; 3. Artificial ants pheromone are quantity which generates a function of the quality of solutions; 4. The artificial ant's profile pheromone timing depends on the specific problem [7]. For example, most of the artificial ants only after the ants are to find a solution to update the pheromone on the path. Sometimes, in order to improve the efficiency of the ACO, in the algorithm predicted that local optimization and backward strategies.

Ant colony algorithm in the pheromone update, no matter how the solution to search, in these pheromone path will have strengthened to a certain extent, and the solution to information search is not better than has been strengthened, but will with the passage of time is not broken volatile and more difficult to search, so the ant colony algorithm more vulnerable to early found better solutions, to fall into the local optimal solution, in order to overcome this phenomenon, we use the following method to update with the reward and punishment mechanism.

The specific process of the ant colony algorithm:

Start:

1) Initialization: NC = 0, the initial path information elements equal to 0.1, n ant corresponding n cities, all the ants set the initial of Tabu (k);

2) All ants calculated transition probabilities; the roulette wheel to select the next city j and city j joined their respective Tabu (k) table;

3) Update on various lines of pheromone, ant - cycle through route plus a fixed value, Trail route through the ant-quantity plus a fixed value divided by the length.

Where η_{ij} (t) = 1 din is the distance ants i and ants j by the above strategy, the ants will not only have a collection of A (t) is more sparse area search, but also where other ants position search in order to accelerate the convergence speed, and also introduces a random number-based search mechanism for a given [0,1] constant W, when the random number z ($\in$ [0,1]) $\leq$ w, according move the above-mentioned transition probability; while when z> w, optionally selected from the collection of A (t) in the solution as the next step in the moving direction of the ant i, and the neighborhood of the Solutions search summary, solving objective optimization problem ant colony algorithm specific steps are as follows: (1) initialize the ant's position in the search space S as well as a collection of a (t), so that t = 0 (2) t = t +1. (3)

produce random number z, z ≤ w, then the search in accordance with the formula (6); if z> w, in the collection of the solution of A (t) is arbitrarily selected as the next moving direction do neighborhood search set of (4) Update A (t). (5) In accordance with the formula (5) to update the content of the pheromone of the ants. (6) If t is greater than the maximum number of iterations, and exit; otherwise, go to step (2).

Whether you choose to iterative optimal or global best ant pheromone update may lead to the stagnation of the search. Stagnation occurred: a selection in each selected points on the pheromone trajectory significantly higher than the other options [8]. Avoid stagnation state: influence is used to select the next solution elements of probability; it is directly dependent on the pheromone track and enlightening information. By limiting the influence of the trajectory of the pheromone, can be easily avoided by the difference is too large between the tracks of each pheromone trajectory limits.

By virtue of the ability of the path optimization according to the results of the bionics home study, the ants can find the shortest path between the nests with food, the principle is that: ants leave a volatile secretions (pheromone path through the following called pheromones) pheromone disappear over time will gradually volatile. Ants in the foraging process capable of sensing the presence and intensity of this substance, and in order to guide the direction of their own movement, tend toward thistle high strength in the direction of the substances move, i.e. the probability to select the path with the time on this path, is proportional to the intensity of the substance. pheromone intensity higher the path select its ant more, then leave on the path pheromone strength is greater, while the intensity of the pheromone and attract more ants, thereby forming a positive feedback through this positive feedback, the ants can eventually be found that the best path, resulting in the most ants will gothic path, as is shown by Fig. 2.

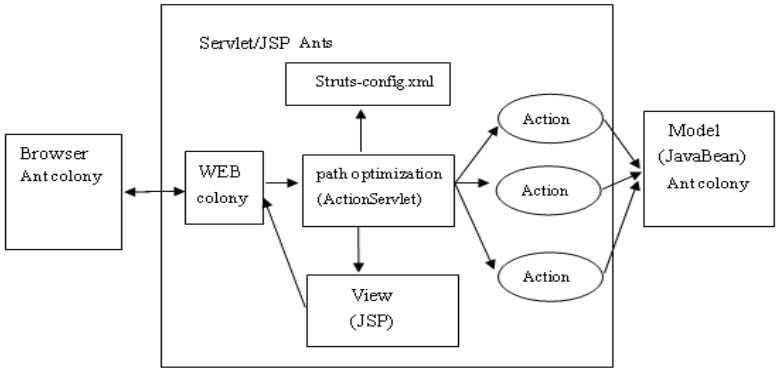

Fig. 2. The principles of rise of the ant colony algorithm research.

With the rise of the ant colony algorithm research, it was found that the ant colony model clustering in some ways closer to actual clustering problem. Ant colony algorithm for cluster analysis, inspired by ants piled their bodies and classification of their larvae. Clustering method based on ant colony algorithm principle can be divided into two types: one is based on the ant heap formation principle to achieve data clustering, another is to use the principle of ants foraging, the use of information to achieve clustering analysis. Data is another important topic of data mining; it is looking for properties in the collection of database objects, and can be divided according to the classification mode.

Gateway (some literature also known as Sink node) is a special node, can communicate with the monitoring center through the Internet, mobile communication network, satellite [9]. Also it can use drones flying over the network, through the gateway acquisition data. The wireless sensor network is still in the research stage, in order to speed up the process of the construction, a lot of foreign demonstration system, relevant theoretical research is also a lot of. In recent years, some domestic research institutes and universities have carried out the research of wireless sensor network theory and application.

The ants have the choice the same line, the line is for the best line; in the actual calculation, given a fixed cycle times but it is difficult to realize in this kind of situation. On the other hand, the actual in him the application, image processing to seek optimal mould plate problems, such as ants and does not require all can find the optimal die plate, only to find that one. The ants are to ask if there is to find the optimal mode plate, and affect the calculation efficiency.

Many applications of wireless sensor networks, and it is typical applications including surveillance, tracking and control. It is generally used in the natural environment monitoring, target tracking, nuclear reactor control, fire monitoring, and traffic monitoring purposes. In a typical business environment, wireless sensor networks are distributed to the region around, to collect data through the

sensor node in it. Area monitoring is a typical application of wireless sensor network. In this application, wireless sensor network is arranged on the need to monitor a phenomenon in the area [10]. For example, the sensor nodes arranged a lot on the battlefield, replace the mine to monitor enemy invasion.

Probability model for estimation of distribution algorithms can be effective pheromone distribution the same time, the distribution of the pheromone can inspire the probability distribution of the model estimation of distribution algorithms, ant colony algorithm pheromone distribution model and estimation of distribution algorithms probabilistic model of phase, as is shown by equation 4.

$$f(t)=f_L(t)+w_L^i(t)+\cdots+w_{M-2}(t)+w_{M-1}(t)=f_L(t)+\sum_{l=L}^{M-1}w_l^i \quad (4)$$

Residual information; the β - inspired importance of information; tabuk - record traversed the city by ant k, called memory list, k = 1,2, ..., m collection tabuk code with the evolutionary process dynamically adjusted after n points in time, all the ants have completed a traverse this case, calculation of the path traversed by each ants Lk of and save the shortest path Lmin = mi The n {of Lk | k = 1,2, ...,m}. ants after the completion of a cycle, the amount of information on each path to be adjusted as follows τ_{ij} (t +1) = (1-ρ) (2) of formula τ_{ij} (t) + $\Delta\tau_{ij}$ ρ ∈ (0,1),represents pheromone τij (t) over time and the degree of attenuation of 1-ρ is the pheromone residual factor start $\Delta\tau_{ij}$ (0) = 0; β is the relative importance of visibility reflect ants choose the path information in the course of the campaign inspired by the emphasis, the greater its value, the state transition probability close to the greedy rules, γ is the parameter indicates the degree of energy is relatively important.

Ant Colony System (Ant Colony System, ACS) ant colony system do the three areas of improvement: state transition rules to provide a better and more rational use of the new path and the use of a priori knowledge about the problem the method global update rules apply only to establish the process of problem solutions, the optimal path of ants in the process of establishing solutions to problems, application of local pheromone update rules.

3. The Optimization Algorithm of Wireless Sensor Network Node

The topology control technology is one of the most important technologies in wireless sensor networks. Generated by the wireless sensor networks, network topology, topological edges between two nodes can communicate directly [11]. If no topology control, all nodes will work with maximum wireless transmission power. In this case, the limited energy of the one hand, the node will be the communication section rapid consumption, reducing the life cycle of the network.

Meanwhile, the radio signal of each node in the network will cover a large number of other nodes, causing wireless signal conflict frequently affect the junction point of the wireless communication quality, reducing the throughput of the network. On the other hand, there are a large number of edges in the network topology will be generated, resulting in a large amount of information of the network topology, routing the computational complexity, waste valuable computing resources. Therefore, we need to study the topology control problem in wireless sensor networks, maintain some of the global nature of the premise of the topology, through adjust nodes transmission power to extend the network life cycle, improve network throughput and reduce network interference, saving the node resources.

Wireless sensor network to monitor the physical world as the main target, is a kind of measurement and control network, node's computing and communication ability is weak, severely limited energy supply. To sum up, the wireless sensor network has the following characteristics: a large scale, high density; no center, self-organization; dynamic network; nodes are resource-constrained; multi-hop routing; based on the data center.

Distributed, self-organizing. The wireless sensor network is a network of peer nodes, there is no central control. Management and networking are very simple and flexible. Not rely on fixed infrastructure, each node has a routing function, by self-coordination, and automatically arranged to form a network, no other auxiliary facilities and artificial means. Using wireless sensor networks collaboration to perception, the perception of the object information acquisition and processing in the network coverage area, and send to the observer [12]. Perception of the object, sensor networks and observer constitute the three elements of the wireless sensor networks, as is shown by Fig. 3.

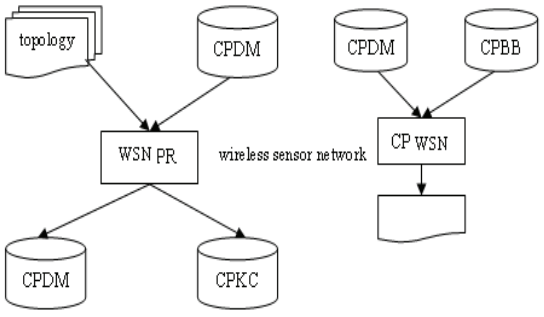

Fig. 3. The three elements of the wireless sensor networks.

A typical wireless sensor network architecture including the sensor nodes, it is aggregation nodes and the management node. A large number of sensor nodes are randomly laid in the monitoring area

network through a self-organizing way. Wireless sensor networks with traditional wireless ad-hoc network, although there are many similarities and common features between the two, there is some essential difference between. Wireless ad-hoc networks through dynamic routing and mobility management technology, to provide users with high-quality data transmission services, is essentially data network node computing and communication ability, and sustained energy supply.

There are many applications of wireless sensor networks in different occasions. In the commercial and industrial fields, some data is difficult to monitor using wired sensors, or the price is too expensive to implement, in this case can be used for wireless sensor networks to monitor. Wireless sensor networks can be deployed in an outdoor environment, they can be placed for years (used to monitor certain environmental factors) without the need to recharge or replace energy equipment. They can form a territorial boundary, and monitor the intruder process of moving (to pass information between the nodes).

Connectivity - in order to achieve mutual communication among the nodes, the topology generated must ensure connectivity; from any one node can send a message to another node. Connectivity is any topology control algorithm must ensure a property. As defined by the UDG graph can know, connectivity of UDG graphs is maximum connectivity network can provide, therefore assume that UDG graph is connected. So, any topology control algorithm is to generate the topology are UDG sub graph.

The characteristics of the wireless sensor network: node miniaturization limited energy supply and harsh environmental conditions node failures, dynamic network topology communications failure problem of a large number of nodes deployed unattended. Topology control algorithm goal is to control the transmission range of the node to satisfy certain properties of the resulting network topology to extend the network life cycle, reduce network interference and improve throughput. Generally assumed junction points are distributed in a two-dimensional plane, all nodes are isomorphic, are the use of non-directional antennas [13]. To graph modeling wireless sensor networks, node i's transmission power Pi is greater than the need to transfer power from node i to node j P_{ij} junction point i to node j between a directed edge. All nodes are generated when the maximum power topology called UDG FIG (Unit Disk Graph). Topology control should be to meet one or several of the following properties of the network topology, as is shown by equation 5.

$$P(k|k) = P(k|k-1) - P(k|k-1)H^T K^T - KHP(k|k-1)^T + K(HP(k|k-1)H^T + R)K^T \quad (5)$$

Wireless measurement system, the support system is very important part of WSN, certainly powered by a battery, and part of data applications, only need a computer to the Internet computer, and the data processing part according to the actual needs of different power supply system. From the figure above, we can see that the biggest advantage of wireless measurement system are three parts to each other there is no hard connection, in other words between them, in addition to the exchange of data, without any physical relationship, so as to effectively avoid the complex inter-interference and the allocation of resources, I think this is the wireless measurement technology vigorously develop key.

Wireless sensor network system is mainly composed of ordinary sensor nodes, aggregation nodes and PC monitoring platform. Ordinary sensor nodes are spread in the observation area, and are responsible for collecting data related to the observed object, and the co-processing of the data after the transfer to the sink node. Aggregation node in the network data is processed and displayed on the PC monitoring platform. Wireless sensor network node design a direct impact on the quality of the entire network, wireless sensor network nodes by the data processing unit, wireless communication unit, sensor unit, the power supply unit group. Under field conditions, the wireless sensor network applications demand real-time monitoring and emergency treatment, the wireless sensor network node design, focusing consider the following aspects: (1) low-power, low-cost, small volume; □ stability; □ scalability and flexibility.

The main challenge is in making low hardware cost and small sensor nodes. Considering this, the sensor node is now mainly at the prototype stage. Miniaturization and low cost solution to hope for a recent and future in microelectromechanical systems (MEMS) and nanoelectromechanical systems (NEMS) field progress [14]. SNM-Sensor Network is Museumtm. Sensor network platform, common general assembly, and it are technology and related topics. And the mainstream computer, there is no official standard for wireless sensor networks, so the interoperability and reusability of hardware and software are low.

WSN node hardware structure, including battery and power management circuits, and it is sensors, signal conditioning circuit, AD conversion devices, memory, microprocessor and RF module. The nodes are battery powered, and once the power is exhausted, the node will lose the ability to work. Power in order to maximize the savings, in terms of hardware design, to maximize the use of low-power devices, RF part of the power cut off in the absence of communication tasks; layers of communication protocol should be energy-efficient in terms of software design, as the center, if necessary can sacrifice some other network performance indicators, in order to obtain higher power efficiency. Sensor battery and power management circuit the memory signal conditioning circuit.

4. The Optimization Algorithm of Wireless Sensor Network Node based on Improved Ant Colony

Ant colony algorithm has its own advantages in the optimization problem to solve the TSP assigned discrete areas of the problem, and shop scheduling problems, and made a lot of progress with the harvest. Optimization for continuous domain, many scholars to study at home and abroad, and it is including real-coded ant colony algorithm and binary encoding of ant colony algorithm. Ant colony algorithm itself is a massive accumulation of positive feedback mechanism optimization algorithm, pheromone pheromone-based and easy to fall into local optimum, resulting in basic ant colony algorithm in continuous domain effect is not obvious.

SOS is an operating system based on event driven operation, the main function of SOS is to support loadable module, a complete system constructed by some small module, construct may occur in the operation of such. In order to support module interface dynamics in, SOS is also committed to support dynamic memory management. BTnut cooperative multi-threading and plain based on C code, a package of development tools and guidelines. At present there is a lot of research into the middleware in the design of middleware for wireless sensor networks [15]. Generally speaking, research direction can be divided into distributed database, mobile agent and an event based model.

Ant colony algorithm is introduced to the discovery of classification rules, the use of the principle of ant colony foraging in the database search, choose randomly generated by a set of rules to optimize coverage until the database can be the set of rules, thus digging out implicit in the database in the rules, to establish the optimal classification model. Ant colony algorithm to search for the initial conditions for the discovery of a set of rules is empty, and the training set contains all the training samples. The ants search time to complete the rule generation, rule pruning pheromone update three tasks. Search to generate a rule and this rule is added to the set of rules while training samples covered by that rule is removed from the training set. If not covered by the number of training samples is greater than the user-defined threshold value, i.e., the maximum is not covered by the number of samples, the above process is repeatedly performed, the final algorithm will be to obtain a set of optimal set of classification rules, as is shown by equation6 [16].

$$\frac{\partial u}{\partial x_1} = u(x_1 + 1, x_2) - u(x_1, x_2) \tag{6}$$

Wireless sensor networks increasingly domestic and international attention as a new information collection technology. This article briefly describes the architecture of the wireless sensor network transport protocol and supporting technologies. Due to the special nature of wireless sensor networks, its development faces many unique issues.

Directed Diffusion is designed for wireless sensor network routing algorithm, which can be viewed as a milepost planar routing protocol of wireless sensor network, then a lot of routing algorithm design is based on the extended to. Its basic idea is a set of nodes generate data (Interest) attribute values are described, the Sink data query request is called "interest" to describe, for example, the region of interest, the name of the event, the acquisition time interval.

Improved ant colony algorithm:

Input: To determine the number of clusters (that is, tracking the number of goals) and predicted by Kaman filter is initialized with the value of each cluster center;

Output: Determine the parameters of the algorithm: the bell-shaped membership function variance, the maximum number of iterations to determine the adjacent iterations membership tends consistent threshold;

1) If Tree contains a single path P;

2) Then for the path P in the junction point of each combination (referred to as β) DO

3) FP[++ length] = item (i);

4) output { item (i) } and its support count [i]/ n;

5) build S T (i) based on Unid_FP-tree;

6) In each layer, the corresponding pixels of the first sub-images obtained from the respective source images respectively corresponding fusion (to the first layer, the first sub-image, for example, the pixels in the pixel until the pixels in the corresponding to fusion, thereby obtaining on the layer corresponding to the pixels at the sub-image details of a band-pass fusion); same processing is performed on the final low-pass filtered image.

7) The β conditions mode structure-based conditional pattern tree Tree and then tectonic β; ∅ ≠ β(8) if Tree then call FP-Max (Tree β β MFI);

8) Else $\{\tau_{ij}(t) = \tau_{ij}(t) + \delta(\tau \max(t) - \tau_{ij}(t))$

9) To generate candidate maximal frequent patterns $C_{max} = \beta$.

In order to verify the performance of the algorithm, we establish a wireless sensor network simulation environment in Matlab. Sensing nodes 40, the communication radius of 60 randomly distributed in a square area of the range of 560 × 850, the sink node coordinates (90, 10). Each experiment is performed 400 times, the experimental results were averaged. This experiment take $\alpha = 2.4$, $\beta = 4$, $\gamma = 5$, $\rho = 2.2$, $Q = 6000$, each node pheromone initialization 7000, each node energy of 300, we assume that each through one node, energy consumption 0.005 % of the original, since the energy consumption is relatively small changes in the experiment of $\gamma = 2$, in the practical application, the value of γ can be based on energy consumption to make appropriate adjustments, or substituting of 70 times, each time released 30 ants, as is shown by Fig. 4.

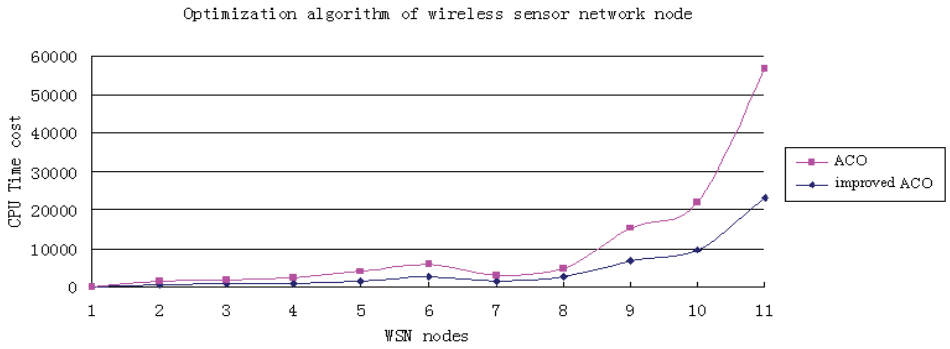

Fig. 4. The optimization algorithm of wireless sensor network node based on improved ant colony.

The paper presents the optimization algorithm of wireless sensor network node based on improved ant colony. To solve this problem, explore other evolutionary algorithm is introduced to solve the pheromone positive feedback accumulated problems, such as the mutation operator of genetic algorithm is introduced into the ant colony algorithm. This hybrid algorithm to some extent alleviated the ant colony algorithm into a local optimum problem, but there is still scope for further research. Draw on the ideas of the hybrid algorithm. This paper introduces the distributed estimation algorithm improvements. Estimation of distribution algorithm is an evolutionary algorithm based on probability model, which itself is based on the statistical characteristics of the ant colony algorithm have great similarity.

5. Conclusions

Wireless sensor network is a large number of tiny sensor nodes with communication and computing power, artificial emplaced, airdrops, artillery projection methods deployed in predetermined monitoring area, constitutes "smart" autonomous monitoring network system. The paper presents the optimization algorithm of wireless sensor network node based on improved ant colony. The ant colony algorithm also known ant algorithm, based on the bionics findings, ants have the ability to find the shortest path between a dangerous thing, and the food source, the principle is that the ants leave a pheromone called path through volatile secretions.

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