An PSO Based Sleep and Wake up Sheduling Algorithem for Wireless Sensor Networks

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Abstract—*Wireless sensor networks include a large number of wireless Sensor nodes together the information from its environment. These sensor nodes for various applications are usually designed to work in conditions where it may not be possible to recharge or replace the batteries of the node, Sleep and wake-up scheduling is one of the fundamental problems in wireless sensor networks, since the energy of sensor nodes is limited and they are usually un rechargeable. The purpose of sleep/wake-up scheduling is to save the energy of each node by keeping nodes in sleep mode as long as possible (without sacrificing packet delivery efficiency) and thereby maximizing their lifetime. In this project, a self-adaptive sleep/wake-up scheduling approach is proposed. PSO (particle swarm optimization) optimization used to choose a best sleep and wake up scheduling for improved performance. PSO shares many similarities with evolutionary computation techniques such as Genetic Algorithms (GA). The system is initialized with a population of random solution and searches for optima by updating generations. However, unlike GA, PSO has no evolution operators such as cross over and mutation. In PSO, the potential solutions, called particles, fly through the problem space by following the current optimum particles***.**

INTRODUCTION

Advances in the wireless communication and the microelectronic technologies have been expediting the development of wireless sensor networks (WSNs). The WSN has lately attracted considerable attention and is widely used for sensing a variety of environment conditions such as temperature, humidity, and density of air pollutant. The main reasons for its popularity are the low price and the ease to form the network. WSN is defined as a network without manager and central coordinator. Usually Wireless Sensor Networks are used in the environment that humans cannot reach. Therefore, sensor devices are distributed randomly and densely in the areas which areabout to be observed. The collective information is directly transmitted by a specific protocol to the operating station or some particular sinks.

The researches in Wireless Sensor Networks could be roughly divided into five fields:

routing protocol, localization, data collection, tolerant, power consume. In general, sensor nodes are small, low-cost equipments and typically subject to a stringent energy constraint.

Hence, energy conservation is a crucial issue for WSNs. How to reserve the power of sensor nodes to increase the effectiveness of entire network is the worthy issue for many researchers. The technology of power saving is separated into four study aspects:

1. The schedule between the sleeping and awakening of sensors: achieves the effectiveness of saving power by sleeping mechanism.

2. Power control is used in sensors to adjust the range of sense: generally sensor nodes are set up at the most sensitive range when sensing, but using power control to adjust the sense range will be able to achieve the effectiveness of saving power.

3. Effective routing path to Sink: as wireless sensor nodes adopt the method of Multi Hops, so how to find a shortest path and make the data transmitted to the sink to reach the throughput of power saving is very important.

4. Reduce the overhead of data: when a sensor node delivers data, other nodes close to it may receive the information that is not transmitted to them. This will cause the consumption of power, so normally the near nodes will be set up to sleep to avoid the happening of overhead.

There are four kind of the energy consumption in WSNs besides transmitting and sensing:

(1) Collision: The collision will occur if there are two nodes want to transfer data to the same node. By this case, the both nodes have to retransmit the data and the energy will be wasted.

(2) Sparse: In normal, the nodes are deployed by random. There will be sparse in some

areas because of the random deployment. The nodes in these areas will consume more energy for transmitting.

(3) Overhead: When nodes transmit data to the other node, the neighbor nodes will receive these redundant data. It will waste the energy for receiving the redundant data.

(4) Idle: There are three status for each nodes which are sleep, active and idle. If stay in idle status with long duration, it waste the energy for listening channel.

In the WSNs, how to efficiently use the energy and prolong the entire network lifetime are the major issues. We will introduce the references which saving energy by sleeping control mechanism. There are two categories of sleeping control mechanism, random sleep time and periodic sleep time. In sleeping control mechanism, there are two parts for each duty cycle which are active status and sleep status. For active status, sensor nodes could communicate with neighbor nodes. For sleep status, sensor nodes will suspend all communication to save energy.

II RELATED WORKS

A self-adaptive sleep/wake-up scheduling approach was presented in the previous work. Unlike most existing studies that use the duty cycling technique, which incurs a tradeoff between packet delivery delay and energy saving, the proposed approach, which does not us duty cycling, avoids such a tradeoff. The proposed approach, based on the reinforcement learning technique, enables each node to autonomously decide its own operation mode (sleep, listen, or transmission) in each time slot in a decentralized manner.

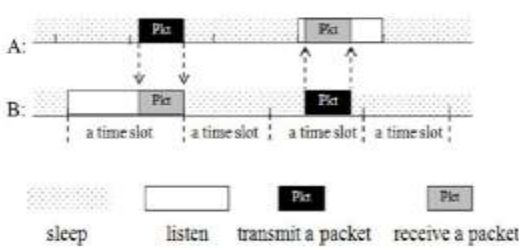

Fig.self-adaptive sleep/wake-up scheduling approach.

In Fig, *A* and*B* are two neighboring nodes whose clocks may not be synchronized. They make decisions at the beginning of each time slot autonomously and independently without exchanging information. There are two points in the figure which should be noted. First, for the receiver, if the length of a time slot is not long enough to receive a packet, the length of the time slot will be extended automatically until the packet is received successfully (see the first time slot of node *B*). Second, when a node decides to transmit a packet in the current time slot and the length of the time slot is longer than the time length required to transmit a packet, the node will also decide when in the current time slot to transmit the packet (see the third time slot of node *B*).

The proposed approach is not designed incorporating a specific packet routing protocol. This is because if the sleep/wakeup scheduling approach is designed incorporation with a specific packet routing protocol, the scheduling approach may work well only with that routing protocol but may work less efficiently with other routing protocols. For example, in sleep/wake-up scheduling approach is designed incorporation with a packet routing protocol. Their scheduling approach uses staggered wake-up schedules to create unidirectional delivery paths for data propagation to significantly reduce the latency of data collection process. Their approach works very well if packets are delivered in the designated direction, but it is not efficient when packets are delivered in other directions.

The contributions of this paper are summarized as follows.

1) To the best of our knowledge, this approach is the first one which does not use the technique of duty

cycling. Thus the tradeoff between energy saving and packet delivery delay, which is incurred by duty cycling, can be avoided. This approach can reduce both energy consumption and packet delivery delay.

2) This approach can also achieve higher packet delivery ratios in various circumstances compared to the benchmark approaches.

3) Unlike recent prediction-based approaches, where nodes have to exchange information between each other, this approach enables nodes to approximate their neighbors' situation without requesting information from these neighbors. Thus, the large amount of energy used for information exchange can be saved.

III PROPOSED SYSTEM

Theory of particle swarm optimization (PSO) has been growing rapidly. PSO has been used by many applications of several problems. The algorithm of PSO emulates from behavior of animals societies that don't have any leader in their group or swarm, such as bird flocking and fish schooling. Typically, a flock of animals that have no leaders will find food by random, follow one of the members of the group that has the closest position with a food source (potential solution). The flocks achieve their best condition simultaneously through communication among members who already have a better situation. Animal which has a better condition will inform it to its flocks and the others will move simultaneously to that place. This would happen repeatedly until the best conditions or a food source discovered. The process of PSO algorithm in finding optimal values follows the work of this animal society. Particle swarm optimization consists of a swarm of particles, where particle represent a potential solution

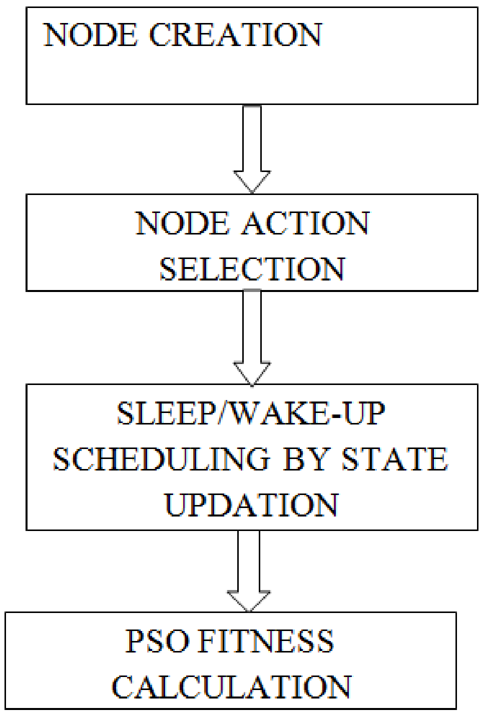

Figure: PSO ALGORITHM

Exploration is the ability of a search algorithm to explore different region of the search space in order to locate a good optimum. Exploitation, on the other hand, is the ability to concentrate the search around a promising area in order to refine a candidate solution[3].With their exploration and exploitation, the particle of the swarm fly through hyperspace and have two essential reasoning capabilities: their memory of their own best position - *local best (lb)* and knowledge of the global or their neighborhood's best - *global best (gb)*. Position of the particle is influenced by velocity. Let x(t) denote the position of particle in the search space at time step t ; unless otherwise stated, t denotes discrete time steps. The position of the particle is changed by adding a velocity, to the current position$x(t+1)=x(t)+v(t+1)$

acceleration coefficient c1 and c2 and random vector r1 and r2 . Simple example of PSO, there is a functionmin f(x)where $x(b)<x<x(a)$ x(b) lower limit and x(a) upper limit

Assume that the size of the group of particle is N. It is necessary that the size N is not too large, but also not too small, so that there are many possible positions toward the best solution or optimal *Second*, generate initial population x with range x(b) and x(a) by random order to get the x1,x2…..xn . It is necessary if the overall value of the particle is uniformly in the search area Then calculate the speed of all particles. All particles move towards the optimal point with a velocity. Initially all of the particle velocity is assumed to be zero. Set iteration i=1 At the iteration, find the two important parameters for each particle j that is: The best value of xj(i) (the coordinates of particle j at iteration) and declare as $p_{best}(j)$, with the lowest value of objective function (minimization case) f[x{j}], which found a particle at all previous iteration. The best value for all particles xj(i) which found up to the I th iteration, Gbest with the value function the smallest goal / minimum among all particles for all the previous iterations, Calculate the velocity of particle *j* at iteration *I* using the following formula using formula (2): Where c1 and c2 , respectively, are learning rates for individual ability (cognitive) and social influence (group), r1 and r2 and uniformly random numbers are distributed in the interval 0 and 1. So the parameters c1 and c2 represent weight of memory (position) of a particle towards memory (position) of the groups (swarm). The value of c1 and c2 is usually 2, so multiply c1r1 and c2r2 ensure that the particles will approach the target about half of the difference Calculate the position or coordinates of particle j at the ith iteration by :

$$Xi(t+1)=xi(t)+vi(t+1)$$

This iteration process continues until all particles convergence the same solution. Usually be determined by the termination criteria (Stopping criterion), for example the amount of the excess solution with a solution now previously been very small.

CONSTRAINED USING PSO ALGORITHM

The following steps are used by the PSO technique to solve the unit commitment Problem

Step 1: Initialize a population of particles pi and other variables. Each particle is usually generated randomly with in allowable range.

Step 2: Initialize the parameters such as the size of population, initial and final inertia weight, random velocity of particle, acceleration constant, the max generation, Lagrange's multiplier (λi), etc.

Step 3: Calculate the fitness of each individual in the population using the fitness function or cost function.

Step 4: Compare each individual's fitness value with its pbest. The best fitness value among pbest is denoted as gbest.

Step 5: If the evaluation value of each individual is better than the previous ppbest, the current value is set to be ppbest. If the best ppbestis better than pgbest the value is set to be pgbest.

Step 6: Modify the λ and α for each equality and Inequality constraint.

Step 7: Minimize the fitness function using PSO method for the number of units running at that time.

Step 8: If the number of iteration reaches the maximum then go to step 9. Otherwise go to step 3.

Step 9: The individual that generates the latest is the optimal generation power of each unit with the minimum total generation cost.

CLUSTERING USING PSO

Fitness function of each particle is calculated for each iteration . Maximum fitness value in each iteration is called as *local_best*and maximum value among all iteration is called as *global_best*. If suppose, *global_best*value is obtained in the *lth*iteration, fitness values of all particles in that particular *lth*iteration are taken into account for cluster formation. Node with the maximum fitness value is taken asreference and constructing the cluster by making the nodes in its radio range as its cluster members. The value of global best is broadcasted to each cluster head so that, each head may aware of the global best node. With reference to the node id the information is being transmitted.

NODE ID	FITNESS
50	10
35	9
40	7
2	6
5	5
7	4
10	3

Table: Fitness value of each sensor node in a network in global iteration.

It can be observed that, the node with maximum fitness value is 10 and constructing the first cluster by making the neighbor nodes as its cluster member which is shown in Fig. 5. For the network with more number of nodes, say 500, more memory is required to maintain the table. To overcome it, fitness threshold may be computed as,fT = fmax/2 (16)

So, it is enough to maintain the table with fitness values greater than or equal to the threshold.

A node called *Cluster Assistant (CA)* is elected for each cluster with maximum fitness value next to the cluster head or cluster particle. The CA for the first cluster is the one which is having a fitness value next to the cluster particle as in the first cluster. The motive of such cluster assistant is to act as a supporting node with the cluster head. These CAs may become a CH if it dies.

IV RESULTS AND DISCUSSIONNODE CREATION

In PSO based routing hundred nodes has been created. Itshows initial node placement and sink node placement

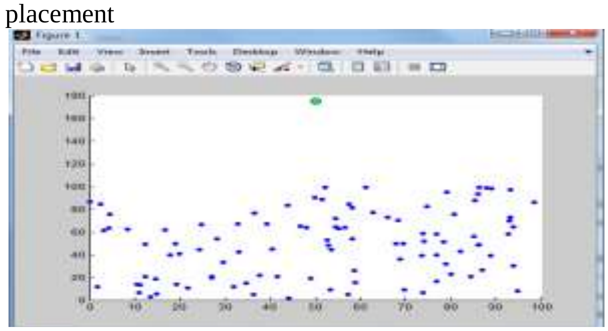

Figure Simulation of node creation

5.2 PARTICLE GENERATION

For each iteration random particles are generated and move with gbest and pbest velocities ,for our simulation for each round 20 round to be iterated ,the particle generation plotted in x axis with corresponding to routing cost in y axis

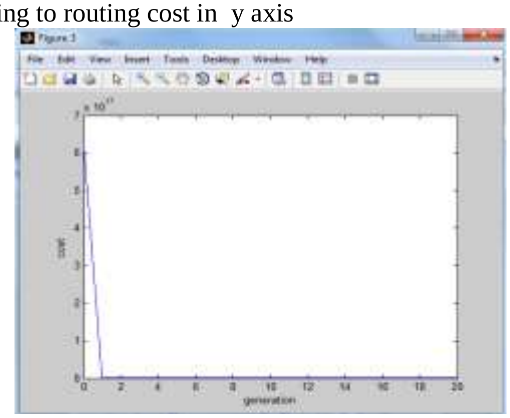

Figure: PSO-particle generation

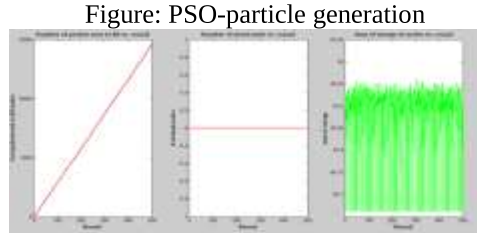

Figure5.3:Noof packets sends to base station

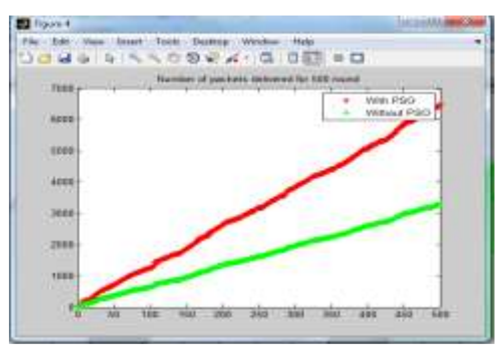

Figure: PSO Delivered Packets Output

V CONCLUSION

Finallyan PSO (particle swarm optimization) base self-adaptive sleep and wake-up scheduling approach. This approach does not use the technique of duty cycling.Duty cycling is often used to reduce the energy consumption caused by idle listening in Wireless Sensor Networks (WSNs). Most studies on WSN protocols define a common duty cycle value throughout the network to achieve synchronization among the nodes.PSO has been a popular technique used to solve optimization problems in WSNs due to its simplicity, high quality of solution, fast convergence, and insignificant computational burden. However, iterative nature of PSO can prohibit its use for high-speed real-time applications, especially if optimization The performance improvement of the proposed approach, compared with existing approaches, may not be big, but the proposed approach provides a new way to study sleep and wake-up scheduling in WSNs.

VI REFERENCES

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