Energy Efficient Target Coverage in wireless Sensor Network

Arpana Patel[1], GaurangRathod[2],Anand Patel[3]

[1]*Electronics & Communication, HasmukhGoswami College of Engineering, Ahmedabad, India*
[2]*Electronics & Communication, Sarvajanik College of Engineering and Technology Surat, India*
[3]*Electronics & Communication, HasmukhGoswami College of Engineering, Ahmedabad, India*

Abstract

Sensor networks have been applied in a wide variety of situations. Recently directional sensor networks consisting of directional sensors have gained attention. Network life is very crucial parameter for sensor network. In this paer, we use artificial intelligence to deploy sensor node with objective of maximize life of network. Simulation results shows that proposed method perform well.

Key Word- *wireless sensor network, deployment, netweork lifetime*

I. INTRODUCTION

Technological advances in recent years have made feasible the deployment of hundreds or thousands of sensor nodes in an ad-hoc fashion, that are able to coordinate and perform a variety of monitoring applications ranging from measurements of meteorological data (like temperature, pressure, humidity), noise levels, chemicals etc. Sensor network generally made of a base station and a group of wireless sensor nodes. Nodes are responsible for monitoring the data and send this data to base station. The base station works as a gateway for the wireless sensor network to exchange data with application to fulfill their aim.

The base stations have continuous power supply and the nodes deployed in sensing area are usually battery operated. The batteries are inconvenient and sometimes even impossible to replace. When a sensor node runs out of energy, its coverage is lost. The mission of a sensor application would not be able to continue if the coverage loss is remarkable. Therefore, the value of a sensor network isdetermined by the time duration before it fails to carry out the mission due to insufficient number of live sensor nodes.

It is both missions critical and economically desirable to manage location of node in an energy-efficient way to extend the lifetime of sensor networks.

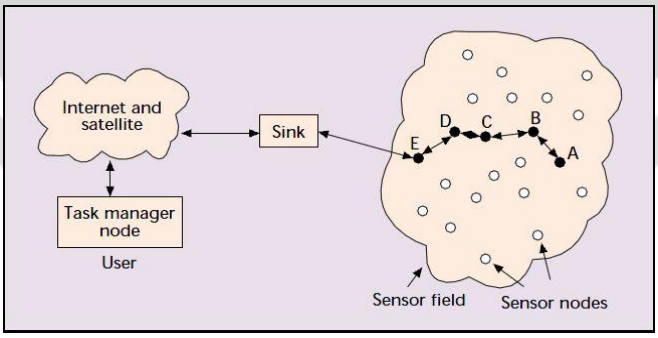

Fig.-1 Sensor network

Coverage in a WSN needs to guarantee that the region is monitored with the required degree of reliability. Locations of sensor nodes constitute the basic input for the algorithms that examine coverage of the network [2]. Coverage problems can be broadly classified as area coverage problem and target coverage problem. Area coverage focuses on monitoring the entire region of interest, whereas target coverage concerns monitoring only certain specific points in a given region. Target coverage can be categorized as simple coverage, k-coverage and Q-coverage. With simple coverage, each target should be monitored by at least one sensor node. For k-coverage, each target has to be monitored by at least k sensor nodes, where k is a predefined integer constant. In Q-coverage [3], the target vector T = {T1, T2, . . . ,Tn} should be monitored by Q = {q1, q2, . . . , qn} number of sensor nodes such that target Tj is monitored by at least qj number of sensor nodes, where n is the number of targets and $1 \leqslant j \leqslant n$.

In deterministic deployment, the details of the region will be known and since a provision of deploying nodes at specific locations prevails many ways by which network lifetime can be maximized. As target location [4] known, upper bound for network lifetime is calculated and it used as a fitness function in artificial intelligence [5] to get best sensor node location to extend network life.

The remainder of this paper is organized as follows. In Section-II and III, we present the proposed deployment scheme for target coverage. Section IV contains the experimental results of proposed method and performances of the proposed scheme.

II. LITERATURE SURVEY

1.amitabhaghosh[a],sajalk.das[b](7): in this paper we study how to maximizing coverage as well as maintaining network connectivity using the resource constrain node is a nontrival problem.

2.mohamedyounis[a],KemalAkkaya[b](4):in this paper we study optimized node placement in sensor network.also to categorized the various approaches in the literature on Node positioning into static and dynamic.

3.mihaela cardie,jiewu(10):in this paper we survey recent contributions addressing energy efficient coverage problem in the contex on static wireless sensor network the coverage problem is subject to be covered target and areaand study about scheduling sensor nodes to alternate between sleep and active mode is an important method to conserve energy resouces.

4.zhao cheng,markpenillo(3):in this paper we study a comprehensive analysis on the maximum achievable sensor network lifetime for different deployment startergies and we study about general network lifetime model to evaluate multiple sensor network deployment strategies.

III PRELIMINARIES AND PROPOSED METHOD

a)Network lifetime calculation:

Considered each sensor had monitoring radius *r*, initial energy J_0 and energy consumption rate is *C* joule per second, then lifetime of node *i*is calculated by

$$\ell_i = \frac{J_0}{C_i},\ 1 \le i \le m \quad (1)$$

A node said to monitored a target if target in the range of node's coverage radius *r* and target monitoring matrix is computed by equation (2). Network lifetime *L* is calculated using equation (3)

$$M_{m\,x\,n} = \begin{cases} 1 & if\ N_i\ monitors\ T_j \\ 0 & otherwise \end{cases} \quad (2)$$

$$L = \left\{ \min_j \left[\frac{\sum_{i=1}^{m} M_{ij} * l_i}{q_j} \right] \right\} \quad (3)$$

where j={1,2, . . ., n}, $q_j$is coverage level and matrix dimension is m x n.

b)Proposed deployment method

Algorithm: Proposed approach

Input:
Number of targets, number of nodes
Output:
Optimum location of node such that maximum network life achieve with required target coverage level
Procedure:

1. Select random location for the given no. of target which are fixed
2. Deploy nodes randomly such that each target must be covered by minimum one node
3. Recomputed node position using ABC algorithm such that network life maximum

c) Artificial bee colony algorithm

Artificial bee colony algorithm The ABC algorithm, proposed by Karaboga from Turkey Erciyes University in 2005 for real-parameter optimization, is a recently introduced swarm intelligence algorithm.

In the basic ABC algorithm, the minimal model in a bee colony that the algorithm simulates consists of three kinds of bees: employed bees, onlooker bees and scout bees. Employed bees are responsible for exploiting the nectar sources and giving information to onlooker bees in the hive about the quality of the food sources (a food source means a feasible solution for the problem with multiple solutions) they are exploiting. Onlooker bees choose a food source to exploit with a certain probability based on the information shared by the employed bees. Besides, Scouts randomly search the surrounding environment in order to find a better nectar source depending on an internal motivation or possible external clues

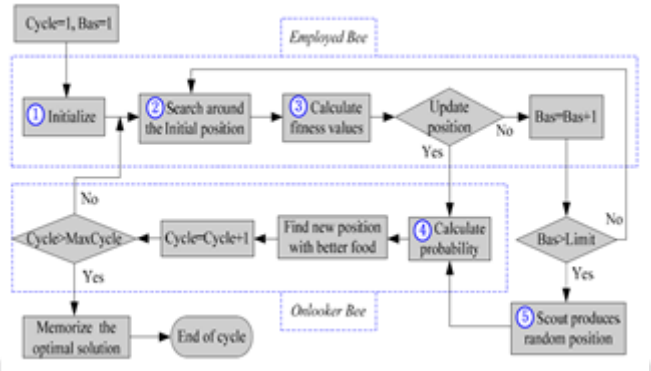

Fig.-2. Artificial bee colony algorithm flow chart

At the initial stage of the search process, the bees start to explore the environment randomly in order to find a nectar source. After finding a nectar source, half of the bees become employed bees and prepare to exploit the discovered source. If the quality of the new position is better than the old, the new position will be memorized. If the source is exhausted, the bee becomes a scout and starts to randomly search for a new source. Onlooker bees choose the employed bees with a certain probability proportional to the quality of the source, and search for a new position around the neighborhood, and check the amount of honey. The bees try their best to find the best nectar with maximum amount of honey

III. RESULTS AND ANALYSIS

Simulation work is done in MATLAB R2009 with below considering parameters of table 1. Output taken as average of 5 times simulated as algorithm first step is started with randomly deploying nodes.

We have done simulation in two phase one for analysis of various parameters of table 1 and other one for to check proposed method's performance.

Table 2 Simulation Parameters

Parameters	Values
Number of targets	25
Number of nodes	100 to 250
Initial energy of node	100 Joule
Coverage radius of node	75m
Energy consumption rate	1 Joule/Second
Coverage type	Simple (K=1)
Topology size	500m x 500m

a) **Analysis of network lifetime**

Before deployment of nodes in monitoring area, it is necessary to analyze effect of each and every parameter. We have implemented deployment using artificial bee colony algorithm and analyze various parameters of table 1 by varying parameters value and note downing network lifetime.

Case I. Effect of number of nodes

By increasing number of nodes and keep number of targets constant, one target covered by more number of nodes. This will increase life of network as shown in fig. 3. Just by increasing number of nodes from 100 to 1500, life increases three times approximately.

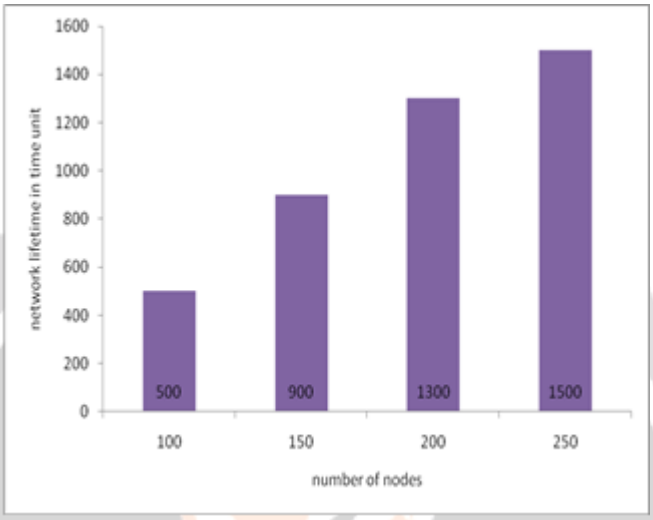

Fig.-3 Effect of number of nodes on network lifetime

Case II. Effect of number of targets

Lifetime of network mostly depends on number of nodes as shown previous and also depends on number of targets. As number of targets increases for constant number of nodes, network lifetime drastically decreases. From fig. 4, as number of targets increases from 20 to 35, network lifetime decreases significantly. When number of sensor nodes is large, then value of number of targets selected carefully because network lifetime changes significantly for more number of nodes compared too few nodes.

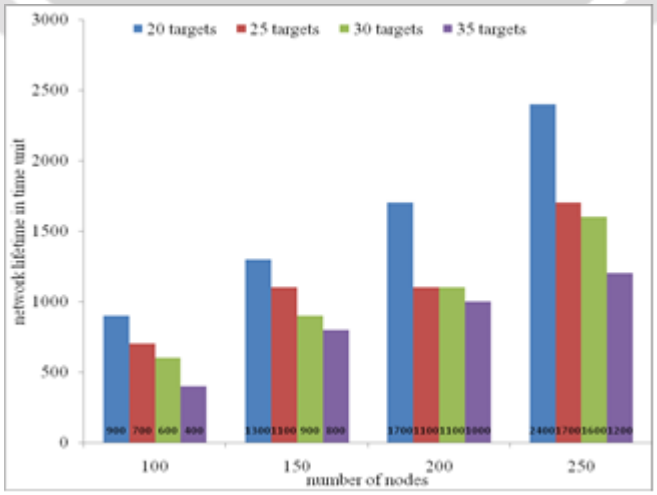

Fig.- 4. Number of targets and network lifetime

CONCLUSIONS

Sensing range of node, size of network, number of target, number of nodes and scheduling have significant effect on life of network which we have done analyses in the simulation by increasing no. of target and sensing area network life decrease but by increasing node's sensing radius life increases with effective coverage level.

By using artificial bee colony algorithm for node deployment, we achieve the required target coverage level and maximize the network lifetime compared to random deployment. Node deployment by using ABC algorithm works good for simple as well as k-coverage application.

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